DOCUMENT RESUME

ED 232 026 CE 036 497

AUTHOR	Uthe, Elaine F.
TITLE	Communications Technology for the Year 2000--with Implications for Vocational Education.
INSTITUTION	Ohio State Univ., Columbus. National Center for Research in Vocational Education.
PUB DATE	82
NOTE	142p.; Appendixes will not reproduce well due to light, small print.
PUB TYPE	Viewpoints (120) -- Reports - Research/Technical (143)
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	*Communications; Computer Assisted Instruction; Computer Oriented Programs; *Computers; Data Processing; *Educational Planning; *Futures (of Society); Information Processing; Postsecondary Education; Reprography; Secondary Education; *Technological Advancement; Telecommunications; *Vocational Education; Word Processing

ABSTRACT

Communications technology must advance to meet the need for improved information processing by the year 2000. Four major technologies are involved: computers and data processing, telecommunications and telephones, reprographics, and word processing. Each of the technologies shows growth in sales, applications, and usage. Facts and projections reveal that probably a 20-year gap exists between the technology and its applications in widespread use. Furthermore, technologies are blurring. Changes in communications technology have social implications in such areas as electronics and consumer finances, health issues related to terminals, the wired home, freedom of information and right to privacy, computer vulnerability, applications and gadgetry, and international concerns. As every individual and every job will be affected by computers, general education and career education (career guidance and vocational training) must integrate the computer as both an instructional tool and as a piece of work equipment. Vocational educators must acquire computer skills and use the computer in teaching job skills and managing the classroom, and vocational education programs must acquire computers and/or computer-powered equipment. (Reading recommendations are made for all vocational educators. Appendixes include articles on the computer and a bibliography of references.) (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED232026

COMMUNICATIONS
TECHNOLOGY
FOR THE
YEAR 2000
--
WITH
IMPLICATIONS
FOR
VOCATIONAL EDUCATION

by

Elaine F. Uthe

University of Kentucky

1982

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
● Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

CE 036497

ACKNOWLEDGEMENTS

Much appreciation is expressed to the National Center for Research in Vocational Education for its support throughout this study. This project was

made possible when I was awarded a Fellowship in the Advanced Study Center at the National Center for Research in Vocational Education at The Ohio State University, Columbus, Ohio, for the academic year, September, 1980, to May, 1981. Their staff, facilities, and resources were most valuable to me throughout the Fellowship.

I wish to express appreciation to the University of Kentucky for granting me leave and for their support during the last year in completing this paper.

The Business Education program at the University of Kentucky has been updated and now incorporates the microcomputer in its program.

All in all, this paper represents only a small fraction of my research and study, for I have also become a microcomputer owner and operator.

TABLE OF CONTENTS

Chapter *Page*

I COMMUNICATIONS TECHNOLOGY 1- 1

INFORMATION PROCESSING AS A SEGMENT OF THE WORK FORCE 1- 2

The Challenge 1- 5
Methods and Procedures 1- 5

HISTORICAL PERSPECTIVES 1- 7

An Historical Perspective--Transportation 1- 7
An Historical Perspective--Communications 1- 8

OVERVIEW 1- 9

II FACTS AND PROJECTIONS 2- 1

COMPUTERS IN BUSINESS AND INDUSTRY 2- 2

Small Business Computers: Users and Usage 2- 5
Computer Applications and Software 2- 5
Computers in Manufacturing 2- 7
Trends in Computers 2- 7

THE TELEPHONE AND TELECOMMUNICATIONS 2- 9

Major Technological Breakthroughs 2-10
Digital Versus Analog Transmissions 2-12
Fiber Optics Technology 2-14
Electronic Mail Technology 2-14

Need for Electronic Mail 2-16
Economics 2-16
Features 2-17
Acceptance by Workers 2-19

Telecommunications 2-21
Competition and Technology 2-23
Electronic Newspapers--Teletex or Videotext? 2-25
Trends in Telephones and Telecommunications 2-27

WORD PROCESSING AND THE AUTOMATED OFFICE 2-27

Economics and Labor 2-27
Office Automation Systems 2-29

  Subsystems 2-29
  Difficulties 2-30
  Personnel 2-31
  Networking 2-34

The Merger of Data Processing and Word Processing 2-35
Reprographics 2-36

  Phototypesetting 2-37
  Copiers 2-37
  Facsimile Systems 2-37
  Computerized Remote Printing 2-38

Electronic Filing and Micrographic Technologies 2-38

  Micrographics 2-38
  Videodiscs or Optical Discs 2-39
  Electronic Filing 2-39

COMPUTER GRAPHICS 2-42

VOICE SYNTHESIS TECHNOLOGY 2-45

  Speech Output 2-45
  Speech Recognition 2-46

SUMMARY 2-47

III CRITICAL ISSUES AND SOCIETAL EFFECTS 3- 1

ELECTRONICS AND CONSUMER FINANCE 3- 2

  The Credit Card 3- 2
  The "Memory" Card 3- 4
  Electronic Shopping 3- 6
  Electronic Funds Transfer System (EFT) 3- 7
  Electronic Retailing Techniques 3- 7

HEALTH ISSUES 3- 8

THE WIRED HOME 3- 9

  Homes and Telecommunications 3-10
  Personal Computers 3-10
  Types of Services and Products 3-11
  Computer Magazines 3-13
  Working at Home 3-14
  Electronic Learning 3-15

COMPUTERS AND PRIVACY 3-15

- Ownership of Data and Information 3-16
- Large Scale Tracking Systems 3-16
- Political Deception by Computer 3-17
- Criminal Justice 3-17
- Areas of Concern 3-17

COMPUTER VULNERABILITY 3-18

- Breakdowns 3-18
- Crime 3-18
- Security 3-20

SOFTWARE APPLICATIONS AND "GADGETRY" 3-21

INTERNATIONAL CONCERNS 3-31

- Technological Espionage 3-31
- International Marketing 3-31
- Transborder Data Flow 3-32

SUMMARY 3-33

IV EDUCATION AND CAREERS 4- 1

COMPUTERS IN EDUCATION 4- 1

- Purposes 4- 2
- Types of Applications 4- 2
- Problems 4- 3
- Special Programs 4- 4

CAREERS AND THE COMPUTER 4- 5

- Types of Workers Affected 4- 5
- Jobs and Computer Skills 4- 5
- Effect of Computerized Automation on Jobs 4- 6

SUMMARY 4- 9

V PREDICTIONS AND IMPLICATIONS 5- 1

THE PREDICTIVE FRAMEWORK 5- 2

PREDICTIONS 5- 4

- Predictions About Computers 5- 4
- Predictions About Computer-Related Functions 5- 6
- Predictions About Education and Societal Effects 5- 8
- Negative Predictions 5-10
- Positive Attitude and Creativity 5-11

THE MICRONICS AGE AND VOCATIONAL EDUCATION 5-11

- Vocational Needs 5-11
- Implications for Vocational Education 5-12
- Recommendations for Vocational Educators 5-14

SUMMARY 5-15

APPENDIX

- A QUESTIONNAIRE
- B Uthe. "Will Teaching Be Different in the Year 2000?" (KBEA Journal, Spring, 1981)
- C Uthe. "Computer Literacy for the Year 2000," (VocEd Insider, November-December, 1981)
- D Uthe. "The Computers In Our Lives," (VocEd, April, 1982)

BIBLIOGRAPHY

LIST OF TABLES

No.	*Title*	*Page*
1	COMPARISON OF CAPITAL INVESTMENT BY INCREASE IN PRODUCTIVITY FOR THREE TYPES OF WORKERS	1- 4
2	PERCENTAGE OF RESPONDENTS BY TYPES OF SMALL BUSINESS COMPUTER APPLICATIONS	2- 6

LIST OF FIGURES

No.	Title	Page
1	FOUR-SECTOR AGGREGATION OF THE WORK FORCE, 1860-1980	1- 3
2	DEVELOPMENT OF SERVICES IN COMMUNICATIONS--INTEGRATED VOICE AND DATA APPLICATIONS	2-11
3	NUMBER OF BITS REQUIRED FOR TYPICAL MESSAGES	2-13
4	A FIBER OPTICS PHONE CALL	2-15
5	DEMAND TRENDS FOR TRANSMISSION OF RECORDS	2-17
6	DRIVING FORCE BEHIND ELECTRONIC MAIL	2-18
7	ELECTRONIC MAIL SERVICE	2-20
8	FALLING COST OF SATELLITE TRANSMISSION	2-21
9	FALLING COST OF EARTH STATIONS	2-22
10	TELETEXT SYSTEMS	2-26
11	PARTIAL LISTING OF JOURNALS IN THE MGMT DATABASE	2-40
12	TREND LINE OPTIONS IN FORECASTING	5- 1
13	A THREE-DIMENSIONAL VIEW OF FACTORS RELATED TO PREDICTIONS	5- 3

CHAPTER I

COMMUNICATIONS TECHNOLOGY

Communications systems will be different in the Year 2000 than they are today, but the degree of difference is unknown. Technology, laws, and public acceptance will influence the direction that communications systems go.

People will still cry, laugh, eat, sleep, pay taxes, and have birthdays in the Year 2000--just as they do today. However, the jobs at which they work, the places in which they work, the houses in which they live, and the way in which they learn may be quite different--partially due to technology. Specifically, communications technology will greatly change careers and personal lives between today and the Year 2000.

The Electronics Age--in fact, the MICRONICS AGE, prevails in business and society today. For the most part, individuals are almost totally unaware of the influence that communications technology has on their personal lives and careers. History will record this decade as the age in which the computer, satellite communications, television, reprographics, typewriters, and telephones were integrated into systems using micronics (miniaturized electronic) systems.

Only a small part of existing technology has been put in practical use for business, industry, government, and personal lives. This lack of use is partially due to lack of creativity in designing practical applications, lack of demand by potential users, and lack of finances to support research, development, and marketing. Some technological advances are delayed because investors in older systems want to recoup investments before financing new technological systems.

The Year 2000 is several years away; yet it is less than a nanosecond (one billionth of a second) away in terms of historical perspective. Predictions about the Year 2000 appear in scenarios by experts in many fields; notably, the Club of Rome's futuristic studies about world environments and the United States' GLOBAL 2000 REPORT TO THE PRESIDENT (Barney. Washington, D.C.: U.S. Government Printing Office, 1980). The latter study focuses on trends and predictions in world population and income as well as resources such as food, fisheries, forests, water, nonfuel minerals, and energy. It discusses the environmental consequences for each by the Year 2000.

Today's demand for up-to-date information has created a need for faster means of gathering, processing, and analyzing data, as well as for easier storage and retrieval when needed. Hence, the computer era and the "office of the future" are teamed together.

INFORMATION PROCESSING AS A SEGMENT OF THE WORK FORCE

A four-segment view of the work force trends from 1860 to 1980 graphically displays the increasing ratio of information processing workers within the labor force (Figure 1). The four segments of the labor force--agriculture, industrial, service, and information processing occupations--have changed in proportion over the years.

The proportion of the labor force engaged in agricultural occupations dropped from 40 percent in 1860 to less than 2 percent in 1980. The proportion engaged in industrial occupations rose from 18 percent in 1860 to an all-time high of 40 percent in the 1950s; since then the proportion has been steadily decreasing until industrial occupations made up approximately 20 percent of the labor force in 1980.

The proportion of service workers in the labor force has been somewhat erratic and has fluctuated up and down from 18 percent in 1860 to 30 percent in 1980. The proportion is on a sharply rising trend now and is expected to continue to rise.

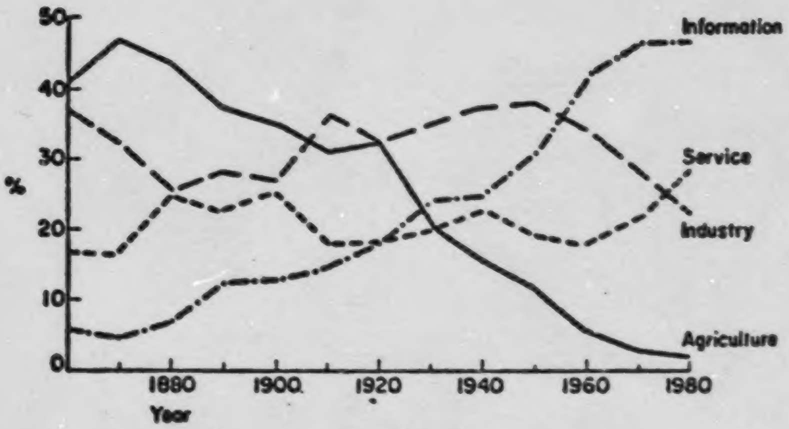
Information processing, however, is the segment showing the most dramatic change. The proportion of workers in these occupations rose from only 5 percent of the work force in 1860 to nearly 50 percent in the 1980s. The demand for information in the form of business statistics, demographic information, marketing analyses, literature searches, global statistics, and news broadcasts appears to be constantly increasing. DATA IS GENERATED MORE RAPIDLY, ON MORE SUBJECTS, AND IN GREATER DETAIL THAN EVER BEFORE. But such data is useful only if it is readily available in a form that can be easily assimilated and swiftly analyzed.

In addition to the increasing proportion of information processing workers in the labor force, comparisons can be made between the workers' productivity and the capital investment for equipment and machinery for various types of workers (Table 1). Capital investment for a farm worker was $35,000 in 1980, $25,000 for the worker in manufacturing, and only $2,000 for the office worker. The increase in productivity during the 1970-1980 decade was 55 percent for the farm worker, 90 percent for those in manufacturing, and only 4 percent for the office.

FIGURE 1

FOUR-SECTOR AGGREGATION OF THE WORK FORCE, 1860-1980

(U.S. Bureau of Labor Statistics)



Consequently, the need for improved information processing is multiplying yearly. Communications technology must advance to meet this need. Four major technologies are involved: computers, telecommunications and telephones, reprographics, and word processing.

TABLE 1

COMPARISON OF CAPITAL INVESTMENT BY INCREASE IN PRODUCTIVITY FOR THREE TYPES OF WORKERS

(U.S. Bureau of Labor Statistics)

Type of Worker	Capital Investment for Equipment and Machinery, 1979*	Percent of Increase in Productivity, 1970-1980
Farm Worker	$35,000	55
Manufacturing Worker	30,000	90
Office Worker	2,000	4

*Other sources estimate these figures at $55,000 for the farm worker and $30,000 for the blue-collar worker.

Information processing combines technologies into systems by using telephones, computers, video displays, facsimile machines, printers, televisions, and keyboards to provide a wide variety of services. Technological advances involve analog and digital transmission of data, sound, and video in new ways.

More technological changes are coming--and at a faster pace than ever before! Therefore, vocational educators must move swiftly to meet today's challenges and to prepare for the future.

THE CHALLENGE

Communications technology is an integration of four major areas--data processing, word processing, telecommunications, and reprographics. Communications technology includes computers, word processors, satellites, television, telephones, and printing/copying processes.

Technological changes occur very rapidly, particularly in the computer and electronics areas; in fact, they seem to multiple yearly and grow more complex. Therefore, we must explore the potential of these communications technologies and their effect on vocational education in a threefold approach:

(1) identify trends in the four technologies

(2) make predictions for the Year 2000, and

(3) identify implications relating to vocational education

Vocational educators and leaders must use these data to prepare for the Year 2000 in terms of program planning, teacher preparation, and curriculum development.

The computer is the focal point of the Micronics Age. The computer links the other technologies together. The distinctions between the four technologies are blurring in the practical world; in fact, they may disappear by the Year 2000.

Education for and about computers is essential; computer awareness is essential for all ages—young and old. Information about careers involving computers must be broadcast far and wide for the computer touches all careers. Many office workers will be users of these machines; thus their training is essential. Other workers from engineers to service workers will also have direct job contact with the computer through a terminal, a microcomputer, and a home computer. Others will be indirectly involved with the computer and may not even know that there is a connection between it and their jobs or personal lives.

METHODS AND PROCEDURES

Futuristic scenarios are developed from a careful study of the past and a review of current data to determine trends. Then extrapolation processes and expert opinion are used to predict the future. The data and information provided here will aid vocational educators in preparing for the future.

Much of the data was obtained from individuals who are highly respected in a technological area; they represented a pool of expert thought, often of a highly technical nature. A four-purpose questionnaire was designed (Appendix A) and mailed to individuals who were considered "experts" in at least one of the technologies. These experts were selected because they (a) held an office in a professional organization related to one or more of the technologies, (b) were president or chief scientist of a major equipment firm, (c) held a governmental position or were managing a federal agency related to one or more of the technologies, or (d) held a faculty appointment at a university recognized for its research/teaching programs in some phase of communications technology.

Each expert was asked for predictions about data processing, word processing, telephoning, telecommunications, and reprographics in three ways: (a) predictions about innovative applications in one or all technologies, (b) predictions about technological inventions in one or all areas, and (c) thoughts about a "futuristic dream" and opinions about major blocks to its achievement.

In addition, and a most important item, each expert was asked to nominate specific resources and other experts with futuristic views. This particular item identified futuristic experts from the respondent's own technological area and was most helpful in identifying resources for other project activities.

Literature searches were conducted both manually and via computers. There were over 950 databases available in 1980, more than double the number in 1978. Many were very specialized although there is a great deal of duplication among some databases.

The computerized library systems at the University of Kentucky and Ohio State University were used for searching the four database considered most pertinent to this study:

ERIC	Education Research Information Center
PSYCH	Social sciences and psychological resources
MGMT	Business and management areas
NTIS	National Technical Information System

The library computer system at Ohio State University was used to update the ERIC and PSYCH searches monthly. In addition, current journals representing different segments of communications technology were used.

Interviews were scheduled with a few selected individuals; reactions to presentations at conventions and in seminars were used in developing a number of the implications.

HISTORICAL PERSPECTIVES

The Year 2000 is nebulous, an unknown quantity; yet some aspects are within the realm of predictions. More technological inventions exist today than are in practical use. Others will be forthcoming as creative ideas and technology linkages occur. Many inventions on the drawing boards today will be in widespread use by the Year 2000; some will disappear if they are not accepted by users.

The computer has existed for several decades; it has been used extensively in scientific research and in large businesses. Only in recent years, however, has the computer become a viable option for small business, for instructional purposes, and in the home.

Many technological inventions were so exceptional that they produced dramatic societal changes in a relatively short period of time. Other inventions that seemed "useful" at first were unsuccessful because they were not assimilated by society. Furthermore, some technology was not considered "useful" and little or no application was attempted, sometimes due to lack of financial resources.

It may be appropriate to review several "unbelievable" inventions from the transportation and communications areas.

AN HISTORICAL PERSPECTIVE--TRANSPORTATION

In 500,000BC a person traveled on foot and averaged 15 miles a day; at that rate the person needed several hundred thousand years to go around the world. By 99,000BC a person could travel by foot the same 15 miles a day or could go by canoe about 20 miles a day; he or she would live in a valley or by a lake. By 1500AD big sailing ships could carry a person 170 miles a day by sea, but on land the person could travel only 20-25 miles a day using a horse and carriage. No one considered it possible to cross a continent or an ocean.

The majority of the technological advances in transportation technology occurred in the last 50 years, however. In 1850 travelers in a covered wagon took 166 days to go from the Atlantic to the Pacific Ocean. In 1860 the same trip took 60 days by stage coach and the traveler would be black and blue at the end of the trip. By 1870 the traveler could go from coast to coast by train in just eleven days; by 1923 the same journey took just over a day (26 1/2 hours) by plane. By 1975 the time to go from coast to coast was reduced to just five hours by jet. Unbelievably, in early 1981 the Space Shuttle Orbiter crossed the nation in just 8 minutes (Insight , National Space Institute, March/April, 1981, p. 8).

The automobile was introduced in this century and it has become a "necessity." It has had both a "good" and a "bad" effect on society. It affects how far we travel to get to our jobs; it is a way of entertainment and a symbol of independence for young people; and it is a contributor to city smog.

AN HISTORICAL PERSPECTIVE--COMMUNICATIONS

Communications technology has changed dramatically also and has had a profound effect on business and society today. Since the advent of the computer in the 1940s, entirely new communications systems have evolved integrating the computer with several other major technologies.

Historically, communications systems have moved from word of mouth to smoke signal systems, handwritten manuscripts, typewriters, and high-speed copiers. Telephones, television, and computers are now joined together in satellite communication systems. Such systems have reduced the size of the world to that of the head of a straight pin. Current communications technology actually involves the integration of a number of "separate" technologies based on a series of inventions over a several year span:

1820	Telegraph and Babbage differential engine
1880s	Telephone, Hollerith card, and typewriter
1920s	Teletypewriter and electric keypunch
1920s	Facsimile service
1940s	Computer
1950s	Direct distance dialing, airline reservation system, and data phone service
1960s	WATS (Wide Area Telephone System) and TELESTAR (first satellite used for communication
1970s	Microprocessors (fourth generation computer)

Many types of inventions in communications technology and computer technology have evolved on a continuous time line from 1930 to 1980; they are expected to continue to multiply in number and grow in complexity until after the Year 2000.

Technology such as the satellite telecommunication system makes it as easy for a person in Lexington, Kentucky, to place a phone call halfway around the world to Paris, France, as it is to call Paris, Kentucky, just 20 miles away. Unbelievable as it may seem, the speed of satellite communication makes it possible to send the entire Bible halfway around the world in just FOUR SECONDS.

A number of twentieth century developments became commonplace in a relatively short time--the telephone, automobile, television, television service, cable television, and the computer. Twenty years in the future, that is, in the Year 2000, we may have and use products that are "unbelievable" in today's world. Much has occurred in the past twenty years, as illustrated by this quotation:

> Had someone told you in 1962 that the 20 years ahead would bring you portable computers, videotape machines, digital watches, microwave ovens, birth-control pills, supersonic passenger planes, and test-tube babies, you might have had doubts. Had someone told you in 1962 that the next two decades would bring you heart and kidney transplants, moon walks, spacecraft on Mars and Venus, discovery of DNA, satellite broadcasts, a Polish pope, an Israeli Jerusalem, a resigned U.S. president, you might have scoffed. (Wallechinsky, David; Wallace, Amy; and Wallace, Irving. THE BOOK OF PREDICTIONS. New York: William Morrow and Company, Inc., 1980, p. 462)

OVERVIEW

The computer has been instrumental in the development of communications systems and in providing the link between processing data and transmitting it at high speeds over telephone and telecommunications systems. Word processing equipment, printers, facsimile machines, and copying machines are also tied into the electronic communications systems.

Vocational educators must be aware of the future perspectives in these areas and plan now to prepare teachers, administrators, and workers to meet the challenges from now to the Year 2000.

Facts and projections about the four major technologies are needed as a basis for making predictions. Then implications will be drawn from these data.

CHAPTER II

FACTS AND PROJECTIONS

Computers form the link between other communications technologies--the telephone, satellites, word processors, printers, and reprographics equipment. Computers control networks, process data according to programmed specificiations, and distribute the results in both electronic and/or paper form. Computer technology is applied to many different tasks.

The computer has decreased in cost and in size but increased in performance. In 1955 a mainframe (big) computer cost several million dollars. Today's programmable calculator, which is small enough to fit in one's hand, performs the same functions at higher speeds than the 1955 computer; yet it costs less than $200. In 1955 the mainframe computer took up a 25- by 40-foot room and required strong floors and air conditioning. Today's electronic calculators with the same capabilities are often as small as a business card and only a little thicker. Furthermore, the time needed to learn to be a computer "user" has decreased sharply.

CRAY-1, the world's most powerful computer, is capable of executing 80 million operations per second; it is worth about $9 million and is expected to be obsolete in about five years. The new S-1 Mark IIA Multiprocessor, reputed to be ten times as powerful as CRAY-1, is currently being developed at Lawrence Livermore Laboratory in California with money supplied by the United States Navy. The CRAY-2 has a 32-million-word memory and a cycle time of 4 nanoseconds in contrast to CRAY-1's 1-million-word memory and 12-nanosecond cycle time.

A 1981 advertisement aptly paraphrases the computer industry's unbelievable strides in productivity and performance:

> If the auto industry had done what the computer has done in the last 30 years, a Rolls Royce car would cost $2.50 and get 2,000,000 miles per gallon.

Each of the major technologies (from computers, telephones and telecommunications, word processing and the automated office to reprographics) shows growth in sales, applications, and usage. Facts and projections about each technology reveal the rapidity of change. Furthermore, there is a blurring of technologies.

COMPUTERS IN BUSINESS AND INDUSTRY

Spending for business data processing continued to rise in 1980 despite a mild recession, according to International Data Corportation (COMPUTER INDUSTRY FORECAST, 1975-1980). They predicted an annual dollar growth of 12 to 14 percent until 1985 in mainframe, minicomputer, small business systems, and desktop computers although the number of mainframe computers is expected to dip a little then. However, services, software, terminals, and communications industry sectors are expected to grow at a faster rate (COMPUTERWORLD, 7/15/80, p. 83).

Cost is generally used as a rough determinate of a computer's size and category:

Microcomputer	Under $3,000
Minicomputer	$3,000 - $150,000
Supermini	$150,000 - $400,000
Mainframe	Over $500,000

The concept of a "local area communications network" (that is, a system of compatible computers, computer peripherals, data terminals, and office equipment such as typewriters or word processors and copiers) has been enhanced by development of "Ethernet," a cooperative standardized network by Digital Equipment, INTEL, and XEROX Corporation. This network (and others) is unique in that terminal access to the line is random, thus speeding up computer access and eliminating waiting time until one user is completely finished (ADMINISTRATIVE MANAGEMENT, February, 1981, pp. 13-14).

"Global" markets for computers have generally been without governmental regulations and financial support, especially in the United States. Companies within the electronics industry itself have developed products and systems independently; in fact, U.S. companies protect their independence fiercely in policy setting, research and development, production according to specified protocols and standards, and marketing plans.

Distributed data processing (DDP involves using a main computer that serves as a processor to geographically separated smaller computers) is expected to more than double from 1980 to 1983 in Western Europe because its countries have devised common protocols, which are different than those in the United States (COMPUTERWORLD, 3/3/80, p. 73).

Approximately 3,300,000 small computers are expected to be installed in the United States by 1984; of these, 375,000 will be small business computers and the remainder will be desktop computers or microcomputers. In contrast, only 236,000 such computers were used in 1979. International Data Corporation also noted that the difference between the two sizes of computers is becoming harder and harder to distinguish (COMPUTERWORLD, 9/1/80, p. 34)

The use of the small "desktop computer" is expected to expand worldwide with the greatest expansion occurring from 1980 to 1985 in the business and professional user area, followed at a much lower expansion rate (and share of the market) by homeowners and hobbyists, scientific users, and educators (FORTUNE, 10/5/81, p. 60).

Many personal computers are being purchased by Fortune 500 companies for executives or departments--often without the knowledge or approval of the data processing division. Marketing efforts for microcomputers have traditionally been aimed at hobbyists; however, the trend is shifting to marketing them to the consumer at home, small businesses (2.3 million companies with fewer than 10 employees exist in the United States in 1980), middle managers (estimated at 15 million), and an estimated 2.5 million technical or professional individuals (BUSINESS WEEK, 12/1/80, p. 91).

One of the biggest obstacles for the personal computer and small business market has been the cost of the printer. Therefore, high-speed, nonimpact printers for business will become an important market factor by 1984. Dot-matrix printers are used for many types of printing jobs now; however, dot-matrix printing has not been considered "acceptable quality" for business correspondence or major reports up to this point.

Many executives do not type and consider it "demeaning secretarial work." Therefore, desktop computers for executives have not been widely accepted. Furthermore, many executives have had insufficient training to use the desktop computer for analysis. XEROX recently introduced a desktop work station for the nontyping executive, one in which the executive touches a pictorial representation of the item on the computer's video screen "menu" rather than keying in commands on the keyboard.

The "executive workstation" (described variously by different experts) is actually an electronic management system that is part of an "electronic" executive desk. The movement to the executive workstation is branching in two different directions:

> A desk with a microcomputer designed to store and search appointments and address lists, to dial phone numbers automatically, to access stock prices and news bulletins, and/or to access databases and information as desired by the executive. The microcomputer will usually include special function keys, "touch" screen menus, and possibly voice activation for easy use by those who do not like to type or use computers.
>
> A desk with a microcomputer supercontroller that merges data, voice, video picturephone, and facsimile channels with various peripheral equipment that is part of the company's network. Typing and computer skills may be required.

Although the idea of the executive workstation was announced in 1980, no units were actually shipped during that year. However, one industry report predicted that 46,000 units at $6,000 each will be shipped by 1983, that 267,000 units at $3,500 will be shipped by 1987, and that 1,260,000 units at $2,000 will be shipped by 1990 (MODERN OFFICE PROCEDURES, May, 1981, p. 82). If so, then approximately 30 percent of the executives in the nation will have electronic workstations by 1990.

Problems may arise when the data processing functions of a company are "decentralized" through a DDP (Distributed Data Processing) system according to PPRO (Public Policy Research Organization, as cited in COMPUTERWORLD, 4/21/80, p. 5). These problems include:

> Hoarding of data and services to boost one's own political power within the organization
>
> More difficulty in managing
>
> Rising costs of installing and maintaining decentralized systems
>
> Stimulation of computing activities (often underestimated from 20 to 100 percent
>
> Rising demand for data processing specialists at decentralized sites
>
> Rising costs of system malfunctions and problems at one site affecting the entire system
>
> Poor comprehension of the system resulting from poor documentation and lack of training

Additional and different problems may arise as the proliferation of desktop computers (of various brands, capabilities, and sizes) occur.

SMALL BUSINESS COMPUTERS: USERS AND USAGE

The sale of the small business computer--the minicomputer--(defined as being priced above $3,000 and under $150,000) is expected to GROW at a 30 to 35 percent annual rate from 1980 to 1984; the "microcomputer" (under $3,000) is expected to grow at more than a 50 PERCENT ANNUAL RATE (MODERN OFFICE PROCEDURES, September, 1980, p. 108).

Furthermore, there are more than 4 million small businesses with fewer than 200 employees (and with more than 6 million offices in homes) to form an attractive marketplace for small business computers. However, the cost of selling small computers to the so-called "mom and pop" market can be an expensive proposition.

Therefore, equipment companies entering the small business computer sales arena are trying new distribution systems--either setting up their own retail stores or service centers or selling through independent chain stores such as Sears and Roebuck, Computerland, or Montgomery Ward.

Both microcomputers and the computer terminals are becoming more "intelligent"; that is, they are easier to use, understandable, transportable, easy to maintain, adaptable and compatible, and upgradable. The computer is becoming more "consumer oriented" in nature.

COMPUTER APPLICATIONS AND SOFTWARE

Computer applications are divided into five major areas: (1) financial and banking, (2) accounting, (3) payroll and personnel, (4) manufacturing, and (5) insurance. Others, such as scientific applications and educational ones, are few in comparison to the total number now.

Accounting and payroll/personnel applications were most prevalent in 1980 (40 percent) but are expected to decrease nearly 10 percent by 1985. Computer applications in manufacturing and other areas, especially education, are expected to increase from 35 percent of the total applications in 1980 to nearly 50 percent by 1985.

This growth in the software market is generally attributed to two factors: (a) a trend to using computers for more specialized, different problems, and (b) increased sales of microcomputers to a broader spectrum of people, businesses, and schools (COMPUTERWORLD, 11/16/81, p. 11).

Two recent surveys provide comparable information about the number of small businesses who use computers and how they use them (COMPUTERWORLD, 10/17/80, pp. 67-68). According to Venture Development Corporation, 25 percent of small companies using computers were service ones, 21 percent were in manufacturing, 18 percent were wholesalers or distributors, and 10 percent were in retailing.

Similarly, Management Information Corporation reported that nearly 50 percent of the computer buyers were small companies that made under $5 million annually. Of these companies, 28 percent were in the services industry, 22 percent were in manufacturing, 14 percent were in wholesaling with 8 percent in retailing, 5 percent in finance, and 2 percent in transportation.

Both surveys reported on the "types of applications" used on the small businesses' computers (Table 2). The three areas that were reported to be the fastest growing were word processing, electronic mail, and graphics applications; many accounting processes were already computerized.

TABLE 2

PERCENTAGE OF RESPONDENTS BY TYPE OF SMALL BUSINESS COMPUTER APPLICATIONS

Type of Application	VDC* (Percentage)	MIC** (Percentage)
Account Receivable	58.6	70.2
Billing/Invoicing	52.6	59.5
Payroll	51.3	57.4
Inventory Control	50.7	46.8
Accounts Payable	50.0	57.4
General Ledger	48.0	57.4
Word Processing	18.4	NA
Electronic Mail	5.3	NA
Graphics	8.6	NA
Sales Analysis	NA	53.2
Management Information	NA	40.4
Cost Analysis	NA	29.8

*COMPUTERWORLD, 8/25/80, p. 3
**COMPUTERWORLD, 10/27/80, p. 68

Although these surveys reported that small businesses in various industrial categories used computers, another highly relevant fact must be considered. In 1980 many (82 percent) of the small businesses still performed their data processing manually (Focus Research Systems, Inc., 1980 survey as cited in SMALL COMPUTERS FOR SMALL BUSINESS, TIME Marketing Research Report No. 2207, June, 1980, p. 18).

COMPUTERS IN MANUFACTURING

The computer is emerging as a tool in controlling manufacturing. U.S. experts predict that:

> By 1990, 25 percent of the plants with fewer than 1,000 workers will be using computer-aided manufacturing (CAM), ...
>
> Computers will generate 50 percent of the paperwork needed to produce or manufacture assemblies as early as 1987 . . . .
>
> Computers will generate 50 percent of the manufacturing plans (Computer-Aided Design--CAD) to build parts or assemblies by 1990 . . . and that CAM will reduce by one third the manual activity in process control development, ...
>
> Magnetic and optical/laser scanning will be used by 10 percent to identify parts for inventory control, ...
>
> It will be 1995 before programmable robots will be used in automatic assembly for 20 percent of the small batch production industry (DELPHI, p. 9)

Robots and microprocessors, that is, robots with artifical intelligence, are emerging as a viable concept in manufacturing. With the microprocessor they are reprogrammable and multifunctional; some can now "see" and "touch." Tireless, more precise, robots work 95 percent of the time in contrast to a human's 75 percent productive time. Advanced models are equipped with vision and tactile-sensing systems to do an entire assembly of operations rather than just one function.

Most robots are in factories but other tasks have been tried, such as shearing sheep, catching correct-sized fish from a tank, processing fruits and vegetables, washing dishes, and serving coffee.

TRENDS IN COMPUTERS

Computers will continue to advance in capabilities and processing speed. They will continue to decrease in size and increase in capabilities at the same time.

Court battles between larger companies over competition, legalities and laws, and regulations will increase, especially in terms of the following:

Transmission of data (enhanced by computer processing) versus "basic service only" by AT&T (American Telephone and Telegraph) and other regulated monopolies

Standardization of protocols, particularly as they relate to "networks" and satellite transmissions

Security procedures, particularly in banking and industrial espionage

Social justice and invasion of privacy issues

Copyrighting of software programs

Computer crime

Software programs will be produced for more applications and will become more sophisicated; yet they will be more readily understandable to the average person.

Traveling to conventions will decrease as telecommunication facilities become available in more hotels and motels, conventions centers, and homes; however, most people attend conventions for both information and socialization reasons. Therefore, many associations will continue to hold conventions but the members will have the option of attending in person or via telecommunications.

Computers will be sold to more small businesses, homeowners, and educational institutions than ever before. This trend will continue at an ever-increasing rate until the 1990s.

Competition in the manufacture and sale of small computers will flourish as the price of components decreases and as more companies, including foreign ones from such countries as Japan, enter the marketplace. The competition will help the customer as companies add more and more features in order to outstrip competitors.

Computer technology will shift from heavy reliance on the silicon chip to other technologies such as fiber optics and Josephson connections; the former is practical now for some industries and the latter is rapidly nearing that point.

Computer technology will be uniquely adapted for the handicapped in such areas as:

a) voice communications for those who cannot speak

b) workstations for the visually impaired or blind

c) controls for prosthetic limbs

d) communication tools for the paralyzed person

Young children's acceptance of computers will be overwhelming but middle-age and older adults will continue to view computers with reluctant acceptance. Some people will refuse to use them at all.

THE TELEPHONE AND TELECOMMUNICATIONS

The telephone in the 1980s is more than a telephone--and it will be vastly changed by the Year 2000. The telephone, a common tool in today's homes and businesses, has changed little since its first days. Yes, the style of the instrument itself has changed from hanging on the wall to a desktop model, from bulky wooden boxes to slimline plastic models to Snoopy contraptions, from basic black to decorator colors. Yes, the switchboard changed from hand-plugged connections to push buttons to computerized switching, from a few to hundreds of lines, from operator-assisted calls to Direct Distance Dialing, and from simple billings to computerized statements that give the time called, the number of minutes in the call, the number called, and the type of charge made.

Satellite transmissions (and computer and television technology) have a tremendous influence on today's telephones. In the 1970 decade alone, the telephone system changed more than it did in the preceding 50 years. Features now available include:

--Touch-Tone dialing (essential for entering digitized data to computers)

--automatic redial

--two-digit dialing of special numbers

--amplifier (so no handset needs to be held)

--paging

--key systems

--internal communications

--door-lock control and burglar and fire detections

--private-line, long-distance telephone service (MCI's Execunet, Southern Pacific's Sprint V, ITT's City-Call, and Western Union's Metro I)

--Picturephones (videophones)

--mobile phones

--telephone answering machines with a multitude of features such as voice-activated recording devices

--"Space Phone" (Zenith Radio Corp.) uses a color television set as an extension telephone for incoming and outgoing calls with a feature for screening incoming calls

--call forwarding

--data transmission between computers

--electronic mail

--teleconferencing

--selective "do not disturb" restrictions

Individuals and companies may now buy their phone equipment rather than renting it from the telephone company.

International calls may be placed using direct distance dialing, and the rates are decreasing rapidly.

The telephone on a business desk, and even in many homes, may house other gadgets such as clocks, calculators, timers, and amplifiers for handfree conversations. In the home the telephone may be in antique French decor or be hidden away in an ornate wooden box.

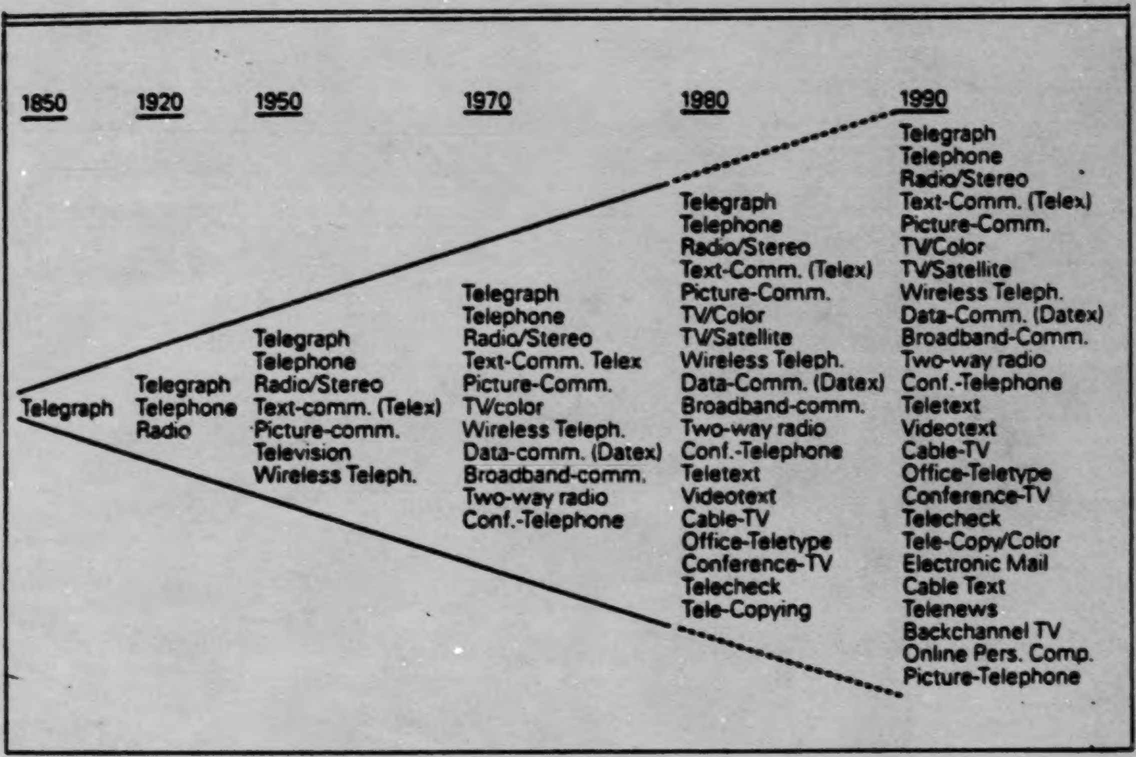
MAJOR TECHNOLOGICAL BREAKTHROUGHS

The telephone will have an ever-increasing importance in communications. The telephone is the contact between computers, copying machines, word processors, televisions, and telecommications networks in addition to the usual human-to-human contacts. The development of the necessary telephone tools occurred over the past century or so (Figure 2); more technological advances are predicted before the Year 2000.

Several important breakthroughs have contributed to the enhancement of the telephone: digitized data in coding and transmission (even voice transmissions) and fiber optics technology. These technological breakthroughs are making new communications links possible, such as those needed for electronic funds transfers.

FIGURE 2

DEVELOPMENT OF SERVICES IN COMMUNICATIONS--INTEGRATED VOICE AND DATA APPLICATIONS



"Integrated Voice and Data Applications," ITT TELECOMMUNICATIONS CONCEPTS SERIES, Volume V, p. 1, no date.

DIGITAL VERSUS ANALOG TRANSMISSIONS

Digital data can be transmitted electronically in on-off pulses and thus it can be transmitted readily over ordinary telephone wires or by satellite. In fact, such data transmission is almost instantaneous. Analog data, however, such as data-voice messages, cannot be transmitted in the same technical way because the voice messages require a continuous (rather an on-off) pulse. The differences in the number of bits required for the different types of messages are given in Figure 3. The typical computer message sent in digital code requires only 500 bits; an entire page in text sent in computer code (1,200 characters) requires 10,000 bits. Consider the bits required for voice (analog) messages in relation to some of the newer services:

1) A voice message of codebook words
2) A typical flip chart
3) A typical electronic fund transfer
4) A typical airline reservation
5) A coded request for library document
6) A fire or burglar alarm signal

Thus, when the tecnological breakthrough in converting voice tones to digitized data was made, it opened up a new era of communications. Digital transmission networks are superior to analog ones for the following reasons:

- Better transmission quality
- Higher transmission rates with lower error content
- Greater privacy through encryption
- Greater reliability, lower costs, smaller weight, and size of systems using integrated circuits
- Greater economy for voice links of intermediate length
- Economy and compatibility between digital transmission and digital switching
- Compatibility with new transmission links
- Compatibility of voice and data
- Future integration of more and different services

FIGURE 3

NUMBER OF BITS REQUIRED FOR TYPICAL MESSAGES

Type of Message	**No. of Bits Rec'd.**
Brief telephone voice message	1 Million
"Vocoder" telephone voice message	100,000
Page of text in facsimile form	200,000
Page of text in computer code (1,200 characters)	10,000
Typical inter-office memo (600 letters)	3,000
Typical telegram (15 words)	400
Newspaper photograph	100,000
High-quality color photograph	2 Million
A color television frame	1 Million
Picturephone frame	100,000
Computer transaction (typical)	500

"Analog and Digital Techniques in Telecommunications," Volume III in ITT TELECOMMUNICATIONS CONCEPT SERIES, p. 12, no date.

FIBER OPTICS TECHNOLOGY

The fiber optics network has greater transmission potential than telegraph (at 200 cycles a second), telephone (3,000 cycles a second), color television (4.6 million cycles). Fiber optics transmission can exceed one billion cycles per second, which is 200 times the capacity of color television. Thus, the transmission of data, voice and other sounds, and video will be no problem in a home wired with fiber optics rather than the copper wire of the present telephone network.

Recently IBM built a silicon chip on an experimental optical receiver. This feat is expected to lead to more economical use of fiber-optic data communication links between computer systems with larger capacity and greater speed than possible through the copper wires of today's telephone systems.

For example, a fiber optic communications cable is being tested for use in ocean environments by Bell Labs. Fiber optics networks already carry telephone calls in West Berlin, Chicago, and Montreal; by 1984 the Bell system will use such networks in the Washington-Boston corridor.

Imagine a system (Figure 4) that can carry 672 different two-way phone conversations at the same time! And believe it or not, fiber optics technology is used in the Saxon plain paper copying machine that is only 12 1/2 inches high!

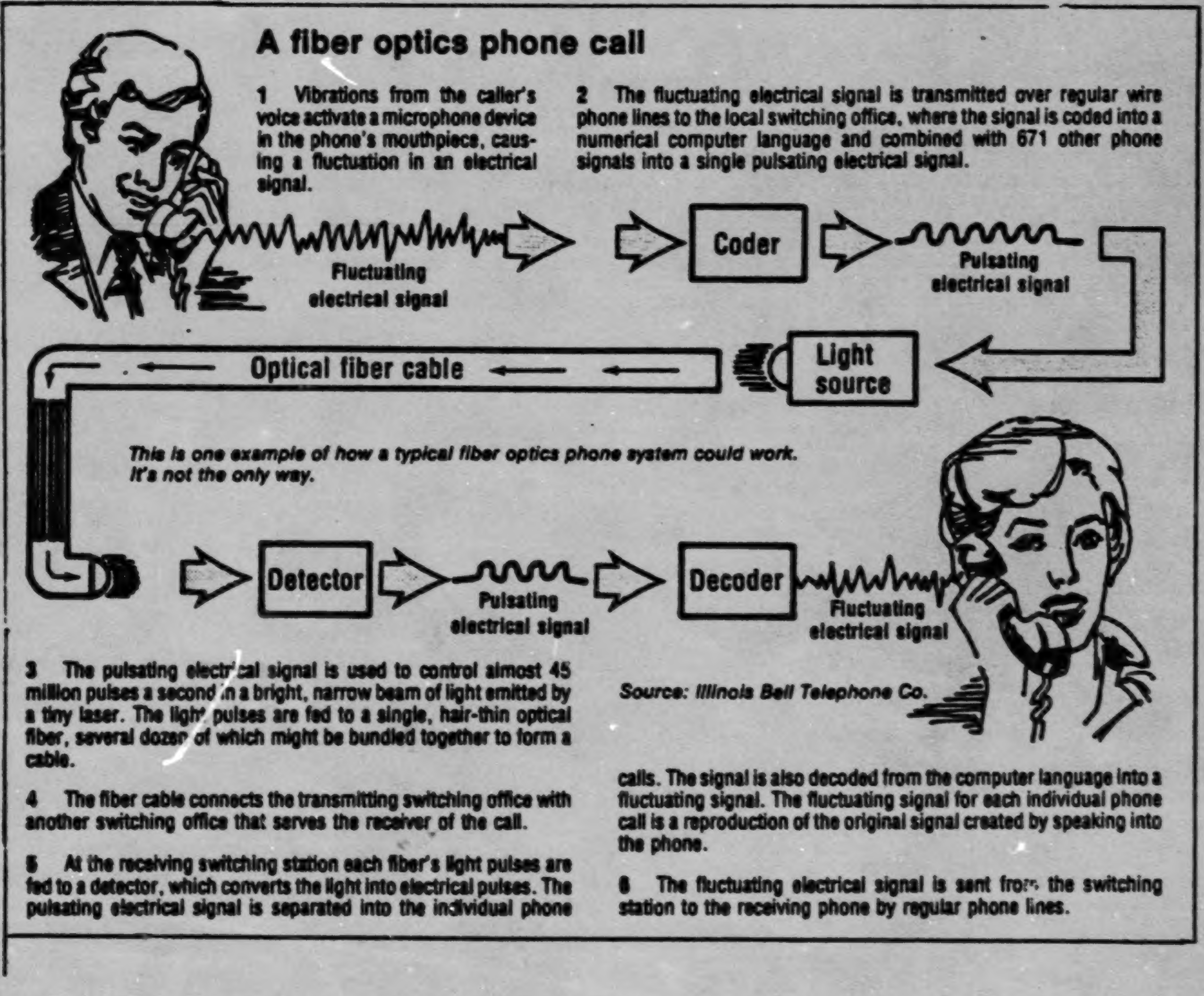
Red tape and finances may retard the growth of the fiber optics telephone networks. First of all, should the telephone company, cable television, or the government develop the system? Second, what happens to the telephone industry's present copper wire system? Indeed, some underdeveloped countries without a telephone system may well be able to support a fiber optics network before highly developed, industrialized nations convert to it.

ELECTRONIC MAIL TECHNOLOGY

New technology that digitizes voice input makes it possible to store voice messages for later use; thus electronic mail is possible. Fierce competition exists between government-regulated monopolies and private companies, such as the U.S. Postal Service with ECOM, American Telephone and Telegraph with Telemail, Western

FIGURE 4

A FIBER OPTICS PHONE CALL



A fiber optics phone call

1 Vibrations from the caller's voice activate a microphone device in the phone's mouthpiece, causing a fluctuation in an electrical signal.

2 The fluctuating electrical signal is transmitted over regular wire phone lines to the local switching office, where the signal is coded into a numerical computer language and combined with 671 other phone signals into a single pulsating electrical signal.

Fluctuating electrical signal
Coder
Pulsating electrical signal
Light source
Optical fiber cable
Detector
Pulsating electrical signal
Decoder
Fluctuating electrical signal

This is one example of how a typical fiber optics phone system could work. It's not the only way.

Source: Illinois Bell Telephone Co.

3 The pulsating electrical signal is used to control almost 45 million pulses a second in a bright, narrow beam of light emitted by a tiny laser. The light pulses are fed to a single, hair-thin optical fiber, several dozen of which might be bundled together to form a cable.

4 The fiber cable connects the transmitting switching office with another switching office that serves the receiver of the call.

5 At the receiving switching station each fiber's light pulses are fed to a detector, which converts the light into electrical pulses. The pulsating electrical signal is separated into the individual phone calls. The signal is also decoded from the computer language into a fluctuating signal. The fluctuating signal for each individual phone call is a reproduction of the original signal created by speaking into the phone.

6 The fluctuating electrical signal is sent from the switching station to the receiving phone by regular phone lines.

Reprinted from MODERN OFFICE PROCEDURES, October, 1980, p. 80, and copyrighted 1980 by Penton/IPC subsidiary of Pittway Corporation.

Union, General Telephone with Telenet, Southern Pactific Communication Company with Datapost, and Tymnet. The technological use of telephone and coaxial cables versus satellite transmission further complicates the issue.

By 1985 electronic mail (store-and-forward voice switching) will be available from AT&T for about 30 percent of the nation's telephones with an additional 25-30 percent of the telephone subscribers able to obtain similar services from independent operators (International Data Corp in INFORMATION HOTLINE, July-August, 1980, p. 10).

NEED FOR ELECTRONIC MAIL. Most existing communication contacts are requests for routine types of information that do not require person-to-person contact. A 1970 NASA study lists the demand trends for transmission of various types of records from 1950 to 1990 (Figure 5). Furthermore, Martin (FUTURE DEVELOPMENTS IN TELECOMMUNICATIONS, Second Edition. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979, p. 266) estimated that nearly 75 percent of the mail currently sent through the post office between businesses, homes, and governmental agencies could be handled by electronic mail.

ECONOMICS. The driving force behind electronic mail is economic in nature. As personnel costs have increased (and information processing is a labor-intensive activity), the cost of electronics has decreased (Figure 6). Thus electronic mail is a high priority for 1990.

At the same time the cost of an electronic mail message decreased from $1.50 in 1977 to 75 cents in 1980. The cost is expected to decrease to under 50 cents by 1983 (INFOWORLD, 10/27/80, p. 27). Furthermore, a computerized data transmission takes fewer bits per message than many other types of transmissions. As a point of comparison, the cost of a traditional letter, according to Dartnell Corporation, rose from $4.77 in 1978 to $6.07 in 1980.

Electronic mail systems *are* designed to encompass the *handling* of messages before and after transmission: research, drafting, editing, addressing, reading, filing, and forwarding. The handling of messages is labor-intensive and therefore makes up the larger portion of the cost.

FIGURE 5

DEMAND TRENDS FOR TRANSMISSION OF RECORDS

(from a study of satellite uses commissioned by NASA)

Type of Record	Formula *	1950	1960	1970	1980	1990
Stolen vehicle information	cases/yr x 10E3	160	320	820	1950	4600
Facsimile transmission of "mug fingerprints, and court records	cases/yr x 10E6	2	4	7	13	25
Stolen property information transfer	cases/yr x 10E3	430	880	1700	3500	7000
Motor vehicle registration	items/yr x 10E6	49	74	110	164	245
Driver's license renewal	items/yr x 10E6	38	48	60	75	90
Remote library browsing	accesses/yr x 10E6	0	0	low	5	20
Remote title and abstract searches	searches/yr x 10E6	0	0	low	8	20
Interlibrary loans	books/yr x 10E6	..	..	low	40	100
Remote medical diagnosis	cases/yr x 10E6	0	0	20	60	200
Remote medical browsing	accesses/yr x 10E6	0	0	20	60	200
Electrocardiogram analysis	cases/yr x 10E6	0	low	20	60	200
Patent searches	searches/yr x 10E6	6	6	6.5	7	7
Checks and credit transactions	trans/yr x 10E9	11	25	56	135	340
Stock exchange quotations	trans/yr x 10E9	0	0	1	2	4
Stock transfers	trans/yr x 10E6	290	580	1200	2500	4900
Airline reservations	pass/yr x 10E6	19	62	193	500	1400
Auto rental reservations	reserv/yr x 10E6	0	low	10	20	40
Hotel/motel reservations	reserv/yr x 10E6	..	..	25	50	100
Entertainment reservations	reserv/yr x 10E6	..	..	100	140	200
National Crime Information Center	trans/yr x 10E6	0	0	6	20	70
National Legal Information Center	trans/yr x 10E6	0	0	low	5	30

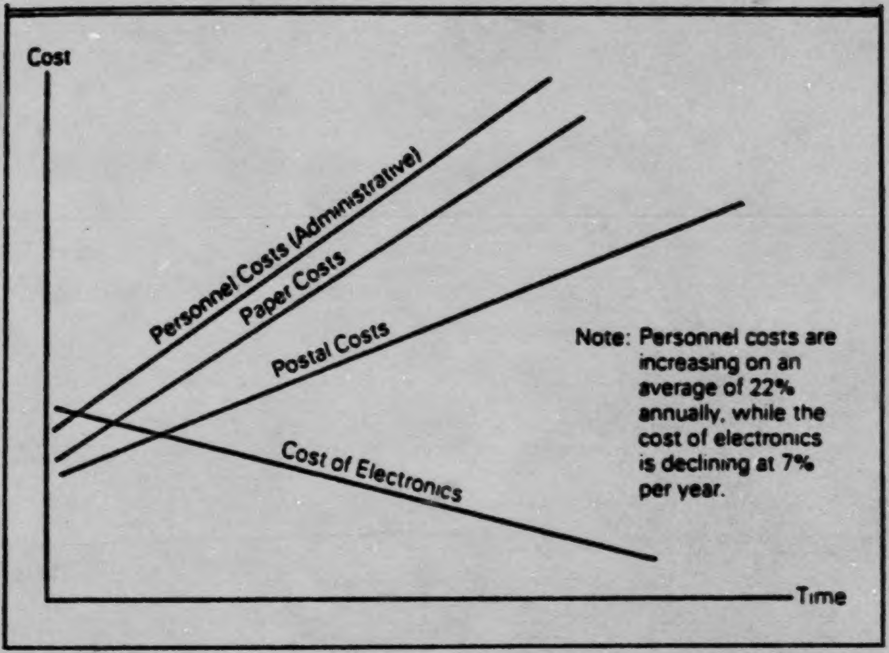
*E = exponential (10 raised to the power of 6, for example)

NASA Contract NAS2-5369, 1970.

FEATURES. The electronic mail service is different than that of telex or facsimile transmissions as these two are only accessible if the person is at the office with the receiving equipment. However, the electronic mailbox is accessible from offices, homes, or out-of-town locations via the telephone.

FIGURE 6

DRIVING FORCE BEHIND ELECTRONIC MAIL



Note: Personnel costs are increasing on an average of 22% annually, while the cost of electronics is declining at 7% per year.

"Integrated Voice and Data Applications," Volume V of ITT TELECOMMUNICATIONS CONCEPT SERIES, p. 11, no date.

A multitude of features are available depending on which electronic mail system is installed; they include:

Procedures for checking accuracy of data and answers

Unlimited message storage for any period of time

Passwords so that only the user can access appropriate files

Messages classified by the sender in four ways--urgent (put on top), private (read only to named recipient), registered (let sender know that recipient accepted delivery of message), and time delivery (deliver message after, before, or within a specified date and time period)

Electronic directory available but requests to be unlisted are possible

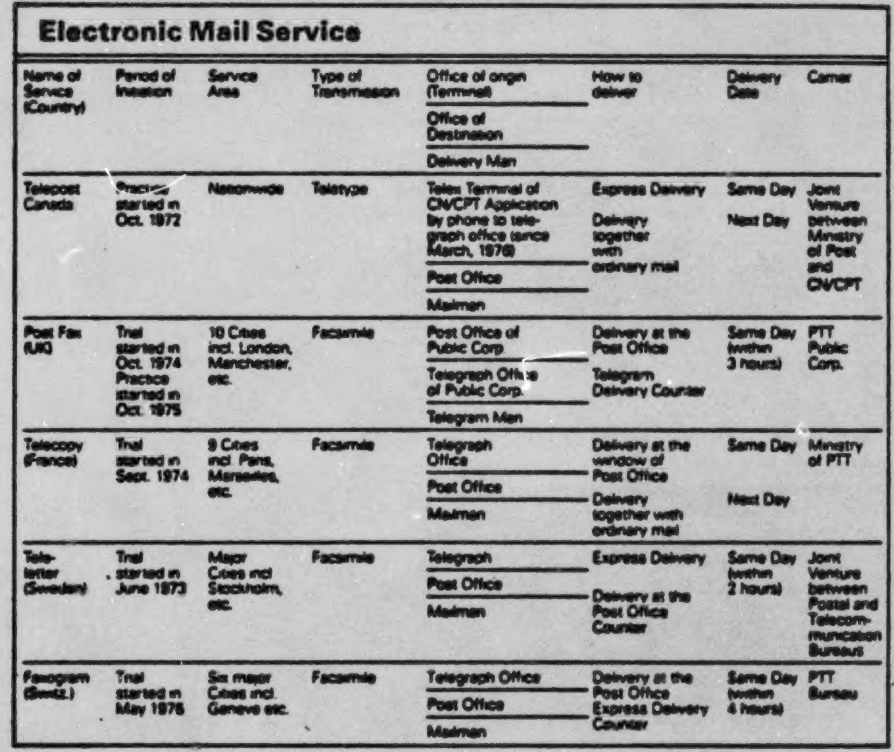
Advanced calling whereby sender sends the same message to a number of callers by simply keying in the telephone numbers (for applications in advertising, sending announcements of meeting times, collection notices, price-change notifications, sales)

ACCEPTANCE BY WORKERS. Managers, professionals, and secretaries who utilized ARPANET (Advanced Research Projects Agency Network, a network between the U.S. Department of Defense research centers begun in 1972) seemed to accept electronic mail transmissions quite well. Managers appeared to like the network more than the secretaries did; the network increased the long-distance communication usage, increased productivity, decreased time on the telephone, increased liking for the job, and increased a feeling of status. Managers also cited the increased flexibility of hours as a feature of the electronic mail network.

Some other countries have electronic mail systems in place and operating effecively on an experimental basis between major cities (Figure 7) also.

FIGURE 7

ELECTRONIC MAIL SERVICE



Electronic Mail Service

Name of Service (Country)	Period of Initiation	Service Area	Type of Transmission	Office of origin (Terminal) Office of Destination Delivery Man	How to deliver	Delivery Date	Carrier
Telepost Canada	Practice started in Oct. 1972	Nationwide	Teletype	Telex Terminal of CN/CPT Application by phone to telegraph office (since March, 1976) Post Office Mailman	Express Delivery Delivery together with ordinary mail	Same Day Next Day	Joint Venture between Ministry of Post and CN/CPT
Post Fax (UK)	Trial started in Oct. 1974 Practice started in Oct. 1975	10 Cities incl. London, Manchester, etc.	Facsimile	Post Office of Public Corp. Telegraph Office of Public Corp. Telegram Man	Delivery at the Post Office Telegram Delivery Counter	Same Day (within 3 hours)	PTT Public Corp.
Telecopy (France)	Trial started in Sept. 1974	9 Cities incl. Paris, Marseilles, etc.	Facsimile	Telegraph Office Post Office Mailman	Delivery at the window of Post Office Delivery together with ordinary mail	Same Day Next Day	Ministry of PTT
Tele-letter (Sweden)	Trial started in June 1973	Major Cities incl Stockholm, etc.	Facsimile	Telegraph Post Office Mailman	Express Delivery Delivery at the Post Office Counter	Same Day (within 2 hours)	Joint Venture between Postal and Telecommunication Bureaus
Faxogram (Switz.)	Trial started in May 1976	Six major Cities incl. Geneva etc.	Facsimile	Telegraph Office Post Office Mailman	Delivery at the Post Office Express Delivery Counter	Same Day (within 4 hours)	PTT Bureau

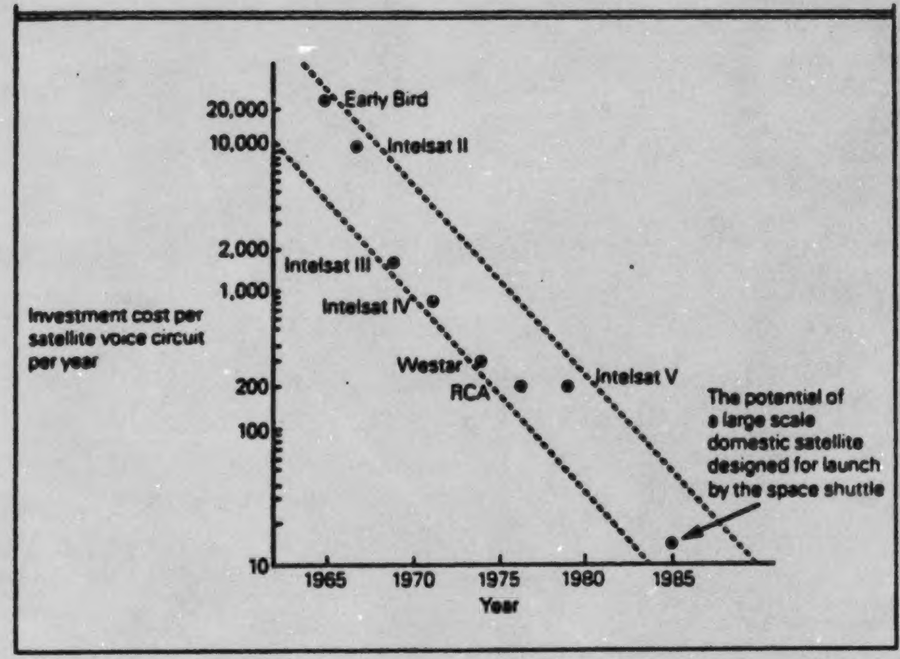
"Integrated Voice and Data Applications," Volume V of ITT TELECOMMUNICATIONS CONCEPTS SERIES, p. 12, no date.

TELECOMMUNICATIONS

The use of satellites for data transmission is a common practice today, especially for large companies with international sales forces, for government-to-government communication as well as television entertainment. The number of satellites increases yearly while the cost of data transmission decreases (Figure 8).

FIGURE 8

FALLING COST OF SATELLITE TRANSMISSION



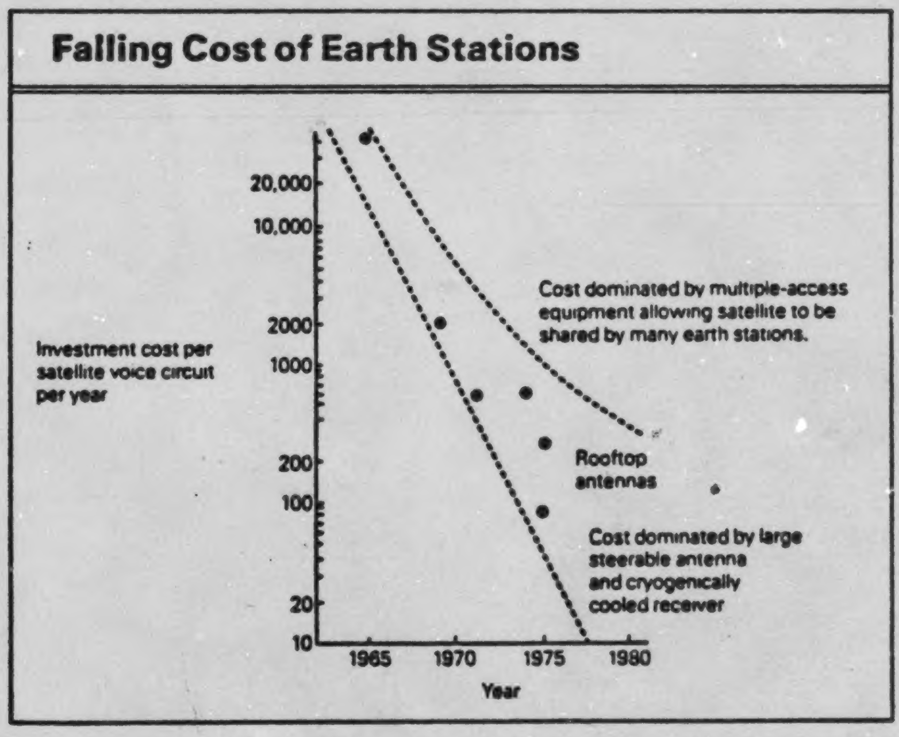
"Integrated Voice and Data Applications," Volume V of ITT TELECOMMUNICATIONS CONCEPTS SERIES, p. 19, no date.

Furthermore, the cost of Earth Stations (required to receive and send data to satellites) has decreased and is expected to decrease more as technologically advanced roof stations become more viable (Figure 9).

The marketing of data processing services has been economically feasible for several years. Data processing companies in New York are able to sell midnight-to-8 a.m. time to French firms that are open at that time because of the difference in time zones.

FIGURE 9

FALLING COST OF EARTH STATIONS



---

*Integrated Voice and Data Applications, Volume V of ITT TELECOMMUNICATIONS CONCEPTS SERIES, p. 19, no date.

There are a number of international concerns, however, as a number of nations are developing prototype communications systems. The policies and problems of interconnecting these systems globally falls into two areas of concerns: (1) policies related to transborder data flow (discussed later), and (2) specifications for equipment standards that are needed if nations are to link together the different systems and networks for worldwide communication.

The Consultative Committee for International Telephone and Telegraph (CCITT) is a forum for member countries of the United Nations to study telecommunications equipment and recommend standards in design and operation. For example, agreement has been reached about standards for facsimile equipment that falls in Group 3 (equipment that sends a letter-sized page in about one minute) in the following ways: (1) the size of paper the equipment handles, (2) the way the document is read by the scanner, (3) the type of code that is used, (4) the methods and speeds at which the information is sent, and (5) the protocol by which the two units establish contact.

COMPETITION AND TECHNOLOGY

Businesses now spend about $30 billion annually for telephone and other electronic communications services. The demand for newer services (high-speed data transmission and video-conferencing) is expected to increase 20-40 percent each year until 1986 while the conventional telephone services will experience only a 8 percent growth rate. By 1990 the total demand for communications services is expected to be more than $150 billion (BUSINESS WEEK, 4/6/81, p. 90).

The value of electronic communications becomes readily apparent when the level of competition is explored. More companies and countries are involved in developing viable systems in an effort to be first.

Competition in TECHNOLOGY exists today between traditional "copper wire" telephone systems, fiber optics systems, and satellite systems. Controversy about "enhanced services" (adding value to data transmission by processing the data during transmission), particularly if offerred by AT&T (a monopoly although a regulated one), has been devisive; in early 1982 AT&T agreed to divest itself of regional telephone companies if it could offer the enhanced services in the future and if it could keep its long-distance network.

The PRIVATE-LINE LONG-DISTANCE AREA is also a very competitive one between AT&T and privately owned companies such as Satellite Business Systems. SBS (owned by IBM and COMSAT, short for Communications Satellite Corp.) plans a network of 20 satellite earth stations to link 150 metropolitan areas that will offer cut-rate telephone service, perhaps as early as 1982.

Competition for selling the COMPUTER-CONTROLLED PBX SWITCHBOARDS for handling both voice and data transmissions is keen between telephone equipment suppliers and data processing manufacaturers. The new CPBX (computerized switchboards) must handle data processing, text and facsimile transmissions, oral conversations, and stored voice messages. Competitors build in various features such as codes for speed dialing of frequently called numbers, automatic redialing when a line is busy, routing of outgoing long-distance calls to least costly routes, and displaying the name of the caller (after retrieving it from the PBX's computerized directory).

Five years ago AT&T held more than 80 percent of the PBX market but held only 54 percent of the 1980 market. Rolm now holds 11 percent, Northern Telecom holds 10 percent, General Telephone & Electronics holds 5 percent, Mitel holds 4 percent, International Telephone and Telegraph holds 3 percent, and foreign companies and others hold 13 percent (BUSINESS WEEK, 4/13/81/, p. 122).

Some information processing companies are marketing specialized LOCAL DISTANCE NETWORKS (LDNs) for connecting office equipment in branch offices. Although these networks cannot handle voice transmissions, they transmit computer data faster than the PBX.

The Brookings Institute attributed 45 percent of the U.S. productivity gains since 1975 to technology, with one third of that gain coming from computers. The next major step must come from improved communications in time-saving applications, better service, speedier equipment, creative innovations, and better organization.

Technological interference may create problems for all types of communications systems as more solar power satellites are developed for operation in the Year 2000. No one yet knows how all these "space" communications systems will operate in the same atmosphere.

Companies updating computers and communications systems in the 1980s face the dilemma of making decisions to build systems around telecommunications (satellites) or coaxial cabling (today's television system).

However, Branscomb, IBM vice president and chief scientist, predicted the increased use of fiber-optic distribution networks locally and satellites for long-distance circuits (COMPUTERWORLD, 6/2/80, p. 45). Branscomb identified two major challenges for the future: (1) consistent interfaces to permit attachment of other equipment to the transmission facility, and (2) international equipment standardization covering interconnections from different manufacturers.

When telecommunication systems operate smoothly, they are extremely useful; but problems do occur and they are extremely disruptive. Problems may include equipment that functions sporadically, the necessity of having a backup system during a total breakdown, a need to change organizational structure for using the system effectively and efficiently, and the need for speedy service.

Investment in telecommunications will bypass traditional telephone copper-wired networks in areas lacking such systems now. An example is the USSR with only one telephone per 13.4 citizens versus the United States with one per 4.3 citizens. Arthur D. Little, Inc., predicted that the worldwide telecommunications equipment market will more than double by 1990 with Asia setting the pace. Five countries (USSR, Japan, Korea, China, and Turkey) plan heavy capital investment in telecommunications (COMPUTERWORLD, 9/8/80, p. 75).

A shortage of satellite data communications facilities may occur by 1984 even though several companies have plans for launching more satellites. In April, 1981, there were 15 major competitors offering various types of such services.

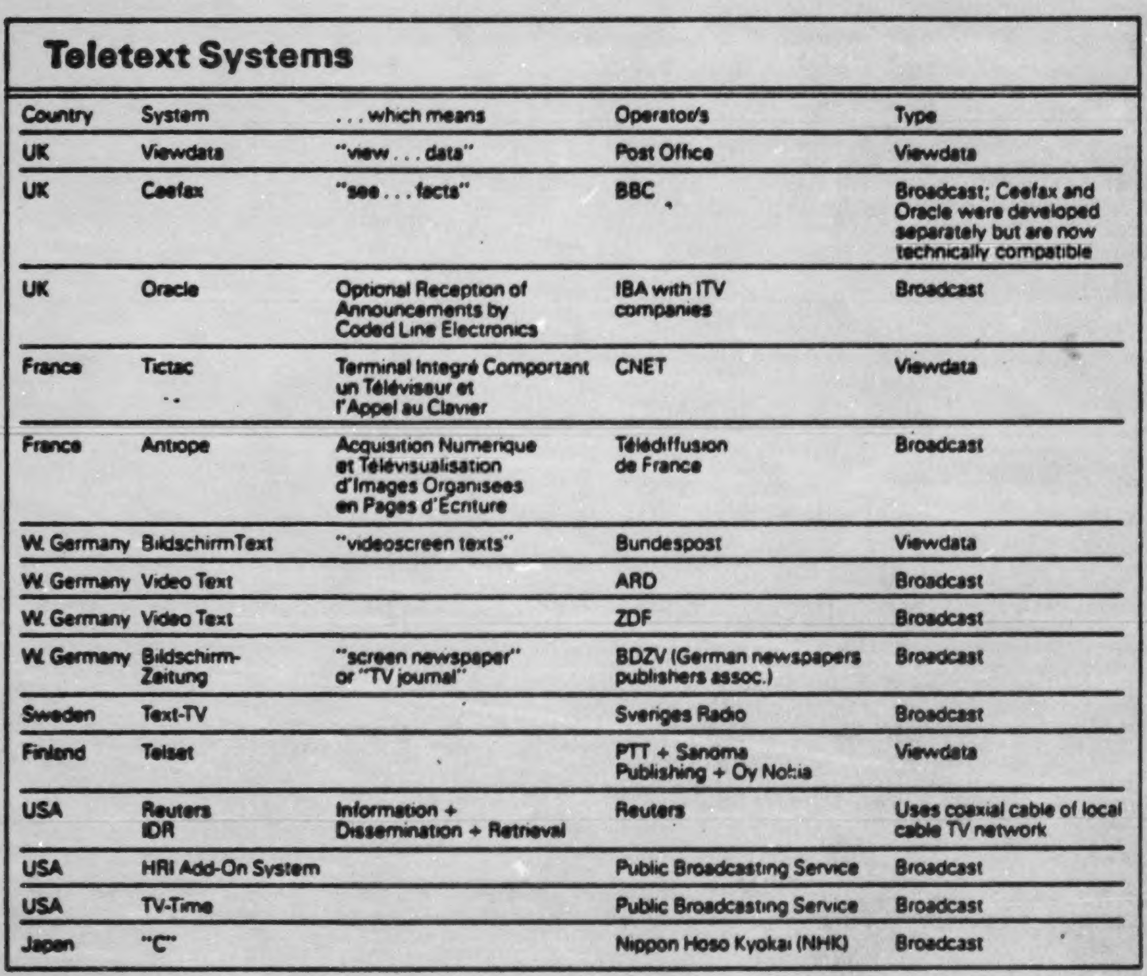
ELECTRONIC NEWSPAPERS--TELETEX OR VIDEOTEXT?

Who will offer "news" in the future? Who will control it? The telephone company, the newspaper industry, the television industry, or perhaps the cable television company? The newspaper industry may compete with all of these because of transmission of news content via television, satellites, and telephones. Who will make editorial decisions about what will be transmitted, about information gathering related to viewers, and about new areas such as electronic shopping and electronic classified ads?

Will the electronic newspaper be based on teletex (one-way transmission systems as used in Europe) or videotext (two-way, interactive systems as used in the United States)? See Figure 10 for a list of such systems.

FIGURE 10

TELETEXT SYSTEMS



Teletext Systems

Country	System	. . . which means	Operator/s	Type
UK	Viewdata	"view . . . data"	Post Office	Viewdata
UK	Ceefax	"see . . . facts"	BBC	Broadcast; Ceefax and Oracle were developed separately but are now technically compatible
UK	Oracle	Optional Reception of Announcements by Coded Line Electronics	IBA with ITV companies	Broadcast
France	Tictac	Terminal Integré Comportant un Téléviseur et l'Appel au Clavier	CNET	Viewdata
France	Antiope	Acquisition Numerique et Télévisualisation d'Images Organisees en Pages d'Ecriture	Télédiffusion de France	Broadcast
W. Germany	BildschirmText	"videoscreen texts"	Bundespost	Viewdata
W. Germany	Video Text		ARD	Broadcast
W. Germany	Video Text		ZDF	Broadcast
W. Germany	Bildschirm-Zeitung	"screen newspaper" or "TV journal"	BDZV (German newspapers publishers assoc.)	Broadcast
Sweden	Text-TV		Sveriges Radio	Broadcast
Finland	Telset		PTT + Sanoma Publishing + Oy Nokia	Viewdata
USA	Reuters IDR	Information + Dissemination + Retrieval	Reuters	Uses coaxial cable of local cable TV network
USA	HRI Add-On System		Public Broadcasting Service	Broadcast
USA	TV-Time		Public Broadcasting Service	Broadcast
Japan	"C"		Nippon Hoso Kyokai (NHK)	Broadcast

"Integrated Voice and Data Applications," Volume V of ITT TELECOMMUNICATIONS CONCEPT SERIES, p. 17, no date.

The United States has the lead in videotext systems, mostly in experimental form. Columbus, Ohio, is the site for an interactive system in which the home audience can respond during the middle of game shows by pushing a button on the home console; the cable television's computer reads and reports the scores to individual questions and later identifies the winner.

TRENDS IN TELEPHONES AND TELECOMMUNICATIONS

The telephone is a vital link in electronic communications now; it is a link between computers, satellites, cable television, word processors, and printers. Its importance is rising dramatically as the demand increases for services such as electronic banking, electronic newpapers, and electronic shopping.

WORD PROCESSING AND THE AUTOMATED OFFICE

Information processing is typically centered in an "office" setting. "Information processing" involves collecting, analyzing, and storing data in meaningful and accessible ways. The computer has speeded up the processing of data and may be the cause of a massive "information glut" in the office also. The computer serves as a tool in handling paperwork and information problems by incorporating systems such as data processing, word processing, electronic filing, electronic mail, computerized reprographic processes, computerized telephone systems, document processing, and time management aids, to name a few.

ECONOMICS AND LABOR

Office workers, one segment of the information processing labor force, made up 29 percent of the total workforce in 1976; that proportion rose to 43 percent in 1980 and is expected to surpass 50 percent by 1985. The office is the most labor-intensive area in business and government. Seventy percent of its cost is directly attributable to labor while only 30 percent is attributed to equipment. Office costs represented nearly 30 percent of the total business costs in 1980 and they are expected to rise to more than 50 percent by 1985.

Costs associated with STORING INFORMATION (filing records, that is) are treemendous. For example, a standard 4-drawer file cabinet costs about $300 a year if update and maintenance times are included. In contrast, a computer's disc file storing the same amount of information costs approximately $15 a year; that cost is expected to decrease significantly in the next few years. Consequently, electronic filing systems and database management are important dimensions in automating the office.

The REPROGRAPHICS FUNCTION in an office is often difficult and slow in comparison with the electronic capabilities of computers and word processors. Impact printers providing letter-quality printout are especially slow; dot matrix printers are used for more applications each year. Research are currently underway to incorporate laser beams and instantaneous photocopy processes in high-speed, letter-quality printers. Jet-spray printers are extremely fast and are available today.

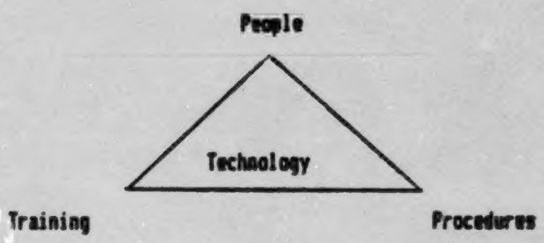
Of the $125 billions spent in the United States on office systems in 1980, $36 billion was spent on the telephone, $32 billion on office data processing, $30 billion on office systems support labor, $26.2 billion on text processing, and $2 billion on office furniture. Of the $26.2 billion spent on text processing, $8.3 billion was spent on reproduction, $6 billion on postal delivery, $5 billion on paper, $2.5 billion on word processing, $1.2 billion on typewriters, $1 billion on electronic mail, $0.9 billion on micrographics, $0.6 billion on calculators, $0.6 billion on mailroom equipment, and $1 billion on miscellaneous items such as answering systems, dictation machines, and many other items (Panko, Raymond R. "Integration in Office Automation: Are We Putting the Cart Ahead of the Horse?" COMPUTERWORLD, 9/11/81, pp. 15-20).

Typically the office has been viewed as the centralized communication and processing function of a business; it has also been considered an "overhead expense" and has been subsidiary to the production and/or service elements of the business. Management (located in the office) organized and coordinated the policy making and planning, marketing, and accounting functions for the company, often with inadequate or out-of-date data.

Today greater emphasis is placed on coordination of increased amounts of data and information from both internal and external sources. However, creating, processing, retrieving, and selecting pertinent data has become nearly impossible because of the vast quantities available. Keeping such data up to date and in usable, accessible form is overwhelming unless the processing, storage, and retrieval systems are fast and provide speedy and easy access to users.

As noted earlier, productivity in the office has not decreased drastically but neither has it INCREASED to keep up with the demand. Adding workers at an increased expense is no longer a viable solution.

Therefore, installation of TECHNOLOGY is viewed as one method of increasing office productivity. Two other aspects need equal or perhaps even greater emphasis: (a) key training and (b) improved operations or methods of doing the work. Simply inventing a new machine is insufficient if it is used by workers with the same degree of skill as before and if the work procedures remain the same.



In 1980 there was one word processor or electronic typewriter for every five secretaries or typists in the United States; BY 1985 THE RATIO IS EXPECTED TO BE ALMOST ONE TO ONE--ONE ELECTRONIC WORD PROCESSOR FOR EVERY SECRETARY OR TYPIST (U.S. Department of Commerce, FORTUNE, 10/5/81, p. 18).

OFFICE AUTOMATION SYSTEMS

Communications technology is tied to efforts to automate the office in order to increase productivity and efficiency and to decrease costs. Past efforts to increase productivity in the office usually centered on time-and-motion studies, workflow systems and procedures, and the electrification of the office. While all these methods are still used, greater emphasis is placed on installing electronic, computerized equipment in the office.

SUBSYSTEMS. There are a series of relatively new subsystems available for office automation today. Some have been used for several years; others are just beginning to be incorporated. A few are still in the research or prototype stage; often the linkage between the subsystems (or between equipment manufactured by different companies) is missing. The subsystems are:

Word processing
Optical Character Recognition (OCR)
Data processing
Reprographics
Micrographics
Communications by facsimile and teletype
Graphic systems
Teleconferencing
Electronic mail
Computerized phototypesetting
Voice-activated sytems

Data processing systems have been used for years for financial recordkeeping in all large and most medium-sized companies. Small companies are beginning to automate their financial recordkeeping functions also because of the increasing availability of small inexpensive computers that are easy to use and have software available.

DIFFICULTIES. The office is a difficult place to automate as there are few standard procedures. The increasing size of procedures manuals testifies to the difficulty of setting and maintaining such procedures. Furthermore, the number of errors, inconsistencies, and exceptional cases multiples the additional clerical and administrative labor costs.

For example, at one time invoicing was a relatively simple task because there were only a limited number of models, perhaps four models of Product X. However, as optional features were introduced to give the buyer flexibility, difficulties multiplied. Product X may still have only four basic models but each one may be purchased with as many as 50 optional features, each one adding to the purchase price. The opportunity for errors in pricing, shipping, and billing multiplied as each option was added.

Another difficulty in automating the office is found in the DATA ENTRY AREA. Typewriting manually (even on electronic machines or computer keyboards) is still estimated to be about three keystrokes per second (or 36 words a minute) according to IBM (COMPUTERWORLD, 9/2/80, p. 14). Therefore, electronic offices and any electronic distribution systems are limited to the weak data entry link. Great efforts are being expended to perfect other data entry means, including voice-activated computers.

The need for office automation has become so important that the American Productivity Center in Houston, Texas, is undertaking an extensive office productivity study called "White Collar Productivity Improvement" (BUSINESS WEEK 3/2/81, p. 49). The types of office automation to be studied include data processing, word processing, communication processing, task processing, augmented management, and corporate control systems.

Office automation systems, to be fully productive, must be user-proof; they must be easily understood by the "average" office worker. Both equipment and data must be safeguarded against misuse and errors made by "unsophisicated" and "sophisicated" users. Therefore, office systems must incorporate these features:

Be user-friendly (easy to use).

Be physically comfortable to use (ergonomics).

Be "hybrid" (have both data processing and word processing capabilities).

Involve communications systems (access to distributed systems and electronic networks of all types).

Have management support capabilities (electronic mail, graphics, calendars, tickler files, etc.).

Incorporate unbundled software and training.

Incorporate new distribution channels (retail outlets, office equipment stores, direct sales).

Have spelling (dictionary) capabilities for proofreading ease.

Include specialized applications software, such as WESTLAW and LEXIS databases for the legal field.

PERSONNEL. Approaches to increasing office productivity focus on two levels of personnel: support workers and management. Office automation attempts to make work easier, process it faster, report it more clearly, and make it more readily accessible for both levels.

The first efforts toward electronic office automation were labelled the "office of the future" and were mainly involved with improving the productivity of only the support workers, the clerical and secretarial personnel.

The "office of the future" concept featured word processing equipment. The total system involved automating as much of the dictation, transcription, filing, and reprographic process as possible using electronic equipment. The word processing function was often placed in a center; it involved the processing of words from dictation into the typed form and often involved reproducing the material in quantity. Text-editing, memory typewriters were first used; then visual display units were introduced. They were used to eliminate much of the routine retyping of reports.

A preliminary analysis in 1979 called "Project Impact," a three-year study of the benefits of office automation by the Electronics Systems Division of the USAF Systems Command, indicated that clerical workers can save 60 percent of the time previously allotted for clerical tasks while professionals doing clerical work could save 50 percent. The office automation system incorporated a mainframe computer and local networking via Mitrenet. Various brands of word processors were connected to the network, and OCR and graphics capabilities were included (FORTUNE 10/5/81).

Although efforts to automate the support workers' tasks are well underway, the process of automating MANAGERIAL/PROFESSIONAL workers' tasks is only beginning. Many managerial workers resisted doing clerical work if it involves typewriting or keyboarding. However, the increasing merger of computer/typewriting capabilities into "desktop computers" is meeting less resistance from the managerial group. Electronic workstations are expected to rise, as mentioned previously. In fact, many large companies are installing these machines in wholesale lots in addition to their mainframe computer and in place of "dumb" terminals (those that only display information as contrasted to "intelligent" ones that permit the user to enter and process data also).

Both managers and professional workers as well as the clerical and secretarial staff are involved in four major functions that may or may not involve operating equipment: writing-related activities, reading-related activities, meetings, and communications/travel. However, the type of involvement and the amount of time are quite different for the two levels of personnel. For example, the manager spends about 35 percent of the time in writing-related activities while the secretary spends only about 18 percent of the time. Both spend time in writing but the manager's time also includes calculating and dictating (FORTUNE, 10/5/81, p. 72).

Furthermore, the same types of contrasts are apparent in other activities as well: 22 percent of the managers' time and 13 percent of the secretaries' time was spent in reading-related activities; 18 percent of the managers' time and 9 percent of the secretaries' time was spent in meetings; and 14 percent of the managers' time and 24 percent of the secretaries' time was spent in communications and travel (including the telephone). Secretaries spent nearly 40 percent of their time in operating equipment in contrast to managers spending only 10 percent of their time in the same way.

Therefore, efforts to automate the managerial functions must be constructed to FIT THE TASKS AT THAT LEVEL.

Booz Allen and Hamilton conducted a managerial and professional productivity study in 1980 to determine how knowledge workers spent their time (Gehring, FORBES, 3/30/81, no page). About 300 professionals in 15 major U.S. corporations were interviewed. Each one carried a device that "beeped" at 20-minute intervals; at the "beep" the person recorded the task being doing at the time and rated the importance of the task on a scale of one to ten.

The managers and professionals in the Booz Allen and Hamilton study spent only 29 percent of their time on "thought work" activities with 13 percent of their time in document creating, only 8 percent reading, and 8 percent analyzing. The managers and professionals spent 46 percent of their time on items that were considered "less productive work," which included seeking information, waiting or idle time, organizing work, expediting, and/or seeking people.

In addition to the AMOUNT OF TIME managers spent on meetings and less productive activities, the project attempted to determine the cost of various types of communications activities. The bulk of such costs in these offices were related to "manual" items: face-to-face meetings, 40 percent of the total cost; telephone calls, 30 percent; and mail, 25 percent. Data communications (video and image or facsimile combined) accounted for only 3 percent of the total communications cost (Gehring, FORBES, 3/30/81, no page).

Communications technology (electronic systems, that is) may assist in increasing productivity at the same or lower cost at some point in the future. Face-to-face meetings via teleconferencing rather than traveling to meet in person may become practical as soon as such facilities become more commonplace in motels and hotels, offices of large companies, and conference centers.

Technology applications in offices and for managers include the following:

Word processing services for creating, editing, and printing of complex documents as well as correspondence.

Document storage and retrieval with computerized indexing and searching by single words or whole texts.

Electronic mail or correspondence systems.

Maintenance of appointment calendars with automatic reminders and the ability to prepare lists of pending tasks.

Automatic generation of memoranda on critical dates.

Processing of information through various modes of input, such as character recognition, speech and voice recognition, and keyboard typing.

Storage and retrieval of information by voice, handwriting, microfilming, and facsimile scanning as well as by keyboard typing.

High-quality, high-speed printing in immediate vicinity and/or in remote places.

Mathematical calculations and updating of data files and/or transactions.
Scheduling of meetings and appointments.

Memory and automatic dialing of telephone numbers, forwarding and recording calls automatically, and setting up conference calls.

Teleconferencing for meetings with both voice and video support.

Financial management support such as general ledger, inventory, customers' mailing lists, sales and production reports.

A survey by FORTUNE indicated that information processing workers at all levels from the president of the company to the secretary will be using electronic workstations by 1985. The same survey of Fortune 100 companies found that features such as integrated data and word processing access, computer-based message networks, privacy controls, and graphics were vital functions in the electronic workstation (FORTUNE, 10/5/81/p. 50).

NETWORKING. Increasing emphasis is now centered on LDNs (Limited Distance Networks). These networking systems link together word processors, computers, copy and facsimile machines, printing presses, and files. They may be linked within the same building or between locations within ten miles. About 90 percent of all business information is distributed within half a mile, according to some experts.

Larger companies established specialized networks in the 1970s; in the 1980s LDNs will be installed by more smaller companies. Twenty percent of the larger companies (those with over $500 million in sales) had LDNs in contrast to only 14 percent of those with sales between $101-500 million, only 9 percent of those with sales between $10-100 million, and 6 percent of those with sales under $10 million. The increases in LDNs in the future, therefore, will occur most often in the smaller firms (FORTUNE, 10/5/81, p. 56).

THE MERGER OF DATA PROCESSING AND WORD PROCESSING

The distinction between word processing and data processing has blurred as word processors acquire calculating functions and database access; in fact, the distinction between a word processor and a microcomputer is rapidly disappearing.

The competition between equipment manufacturers contributes to the increase in features on both the word processor and the microcomputer. New names in "typewriting" equipment appeared in recent years: Wang, Exxon, Xerox, Lanier, Sony, to name a few. Manual typewriters are rapidly disappearing; electric ones are disappearing, too. In fact, THE ELECTRONIC TYPEWRITER MAY DISAPPEAR BY 1985; IT WILL BE REPLACED BY A MICROCOMPUTER.

The merging of data and word processing functions incurs problems related to the capabilities of the electronic equipment as well as the format used in storing and accessing data, especially in formatting and editing commands used with the various machines.

Networking for distributed data processing (DDP) may use existing phone lines for quick, easy access to networks. However, the current phone switchboards carry only certain types of signals; they cannot carry video signals or very high-speed data rates. Therefore, some companies are installing computerized switchboards that handle digital as well as voice signals and at a speed that is useful in most office applications. A few companies (and most office buildings under construction now) are installing coaxial cable networks to carry all types of data, including voice and video.

Furthermore, the distinction between word processing and data processing functions has become volatile; the question of management responsibility for both areas becomes important. Should there be two managers, or only one? If only one, should the person have a data processing or a word processing background? Is it possible for one person to have both?

As the data and word processing technologies merge, a new type of manager may be in order. Job titles found in current advertisements include information processing manager, director of office technology, MIS manager, director of office productivity improvement, information resources manager, director of DP/WP, and director of information technology. Most employers expect these managers to have a broad background and experience in management principles, human relations, telecommunications, text and data processing, marketing strategies, accounting, operational procedures, and systems analysis. Some companies require the manager to have an electronic engineering background, especially if a new system is being installed.

REPROGRAPHICS

Reprographic technologies involve all types of copying machines and printers. They perform important functions in the electronic office. Technologies developed in recent years include the electrophotographic process of which the zerographic system is the principal type, ink jet printers, and plain paper copiers. These processes have greater versatility, higher production speeds, and simplified operations for the user than the impact printers.

Copiers are smaller in size, more powerful in producing good copies, and more reliable than ever before. In fact, copying technology may be too good in some respects as the machines can reproduce checks that are cashable, dollar bills that will fool some change-making machines, postage stamps that look real, and even drivers' licenses. Consequently, the copier industry is developing new products and techniques. Inks that do not reproduce are used in the "missing dots" technique on checks; checks come from the printer with dots of different sizes. When the smaller ones in a special ink do not reproduce, the gaps spell out "void" on the copy.

Printers are expensive, especially letter-quality ones and those that reproduce in color. Many letter-quality printers are impact machines involving mechanical parts; they are slow and usually require more service than nonimpact ones.

Dot matrix printers are faster, print bidirectionally, and are less expensive than the impact printer. However, companies have not accepted the dot matrix appearance as acceptable for correspondence yet. The dot matrix printers are used extensively, however, for addressing bulk mailings, in-house reports, and other materials.

The ink jet printing process is a nonimpact technology and is extremely fast. It produces high-quality material and is gaining in popularity.

The newest and fastest printing technology uses light in the form of laser beams. This process enables the computer user to design logos, forms, characters, and symbols on the computer screen and then print them (each one an original) using a laser beam. One company introduced an electronic printing system in 1980 that is 40 times as fast as typical word processor printers and can send or receive a page of text in three seconds. It combines word processing printing, electronic mail, remote computer printing, and direct copying features into one unit. Business forms are created electroncially, stored in digital form, and then converted to printed images by a laser scanner providing resolution of 90,000 dots per square inch (quality comparable to offset printing).

Demand for color reprographics in both the copier and the printer technologies is extremely high, especially as the computer's graphics capabilities increase. Color is available in four major types of printing techniques—dot matrix, impact, nonimpact ink jet, and color camera.

The computerized, electronic world incorporates reprographic technology in several ways:

PHOTOTYPESETTING. Word processors are available with special options for phototypesetting; they have access to literately hundreds of type styles and type sizes, even foreign language fonts. These machines may be connected directly to the printing presses so that material is typed only once.

COPIERS. Word processors can be connected directly to copying machines via LDNs so that the typist may simply use the word processor to convey the typewritten text directly to the copier (in the same building or across the nation) and specify the number of copies needed.

FACSIMILE SYSTEMS. Facsimile systems use telephone lines and telecommunications systems to convey printed and handwritten material from one place to another rapidly and in exactly the same form as the original.

COMPUTERIZED REMOTE PRINTING. A combination of technologies enables the editorial offices of publications such as the WALL STREET JOURNAL and TIME to prepare material in a New York office, send it by satellite to printing presses in another region of the nation or world to be printed locally. Such a process saves postage and freight, saves time and typesetting costs, and makes it possible to include regional news without difficulty.

ELECTRONIC FILING AND MICROGRAPHIC TECHNOLOGIES

Information storage, especially important in view of the tremendous amounts of information being generated yearly, must change to meet the challenges of the electronic age. Electronic filing uses the computer to store and retrieve information on magnetized discs and tapes; micrographic technology uses film to capture the printed image from paper (or directly from the computer memory).

Both electronic filing and micrographic technology have advantages and disadvantages. The micrographic approach is best for archival records, graphic materials, documents requiring legal acceptance, and corporate histories; it is less expensive than the electronic filing process. On the other hand, electronic filing is best for detailed indexing, query systems, time-sensitive information, and data manipulation. These distinctions may blur as technological advances occur in the next few years.

MICROGRAPHICS. Micrographic filing systems have existed for many years. However, enhancements are continually employed to keep such systems viable in the electronic age.

Computer Output Microfilm (COM) technology produces digitally processed information in microfilm or microfiche form at a faster speed than a computer can print the information on paper. When combined with Computer Assisted Retrieval (CAR), the microforms are linked to the indexing and searching capabilities of the computer. Thus, documents can be randomly accessed and be viewed either on a separate viewer, on the computer terminal locally, or at a remote site. If needed, a COM recorder can make a duplicate of the document.

A new development called Computer Input Microfilm (CIM) makes it technologically possible to digitize microfilm. Then an OCR (Optical Character Recognition) scanner is used to input (transfer) microform data into the computer.

Another development makes it possible to update microfilm thus extending the applicability of microfilm. Updating (that is, annotating, deleting, altering) becomes a relatively simple process when technology is used to re-activate sensitized material in the original film. This updating capability enables a company to revise manuals and other archval materials without duplicating and re-indexing microfilm files.

VIDEODISCS OR OPTICAL DISCS. The videodisc (also called optical disc) is another form of storage that combines sound, video, and computers for random access by laser beam. At present, the videodisc "records" (they resemble stereo ones in size and shape but do not have grooves) are a one-time recording and are limited in usage to materials that do not need continually updating. They are, however, useful for relatively stable information, such as training programs and education, archival files, and permanent data. Although they are expensive to develop, their main advantage lies with the computerized random access to any of the 54,000 tracks containing slides, motion films, and sounds. Thus the user can develop individualized "programs" from the available materials. The process of using video in combination with data and sound is a highly desirable feature of the videodisc.

ELECTRONIC FILING. The micrographic process and electronic filing system, as well as the videodisc process, are in competition as the information storage method of the future. As computer power, reliability, and costs decrease, the electronic filing process will probably dominate the field; however, micrographic systems thrive on the business world's dependence on paper (in the U.S. alone, the banking industry processes and microfilms about 32 billion checks per year with expectations of a 5-7 percent increase per year until the Year 2000).

Digital optical discs (much like the consumer videodiscs) may replace magnetic tape and discs, particularly for data storage, archival information, geological figures, and computer graphics applications. Costs for these types of storage are less than other forms and they are all considerably cheaper than the proposed magnetic bubble memory.

There are over 950 databases (computerized files) available to the computer user presently; in addition, every company with a computer is involved in the database management of its own records.

Many databases are accessible in the reference rooms of public libraries, by purchase from commercial firms, through membership in specialized groups (i.e., the horsebreeders' association), or from the government. Each database is a storage of information; the computer is used to search the indexed materials using dates, "dictionary" words supplied in the database's thesaurus, and cross references of terms in a matrix form. Care is needed in developing the index to such databases as well as in developing a query to retrieve data. Otherwise, voluminous amounts of data (often unrelated to the specific topic) are retrieved.

The MGMT database, for example, indexes items from over 282 periodicals (plus new books); a partial listing appears in Figure 11.

FIGURE 11

PARTIAL LISTING OF JOURNALS IN THE MGMT DATABASE

AACSB Bulletin
ABACUS
ABCA BULLETIN
ACADEMY OF MANAGEMENT JOURNAL
ACADEMY OF MANAGEMENT JOURNAL PROCEEDINGS
ACADEMY OF MANAGEMENT REVIEW
ACADEMY OF MARKETING SCIENCE JOURNAL
ACCOUNTANCY
THE ACCOUNTANT
THE ACCOUNTANT'S MAGAZINE
ACCOUNTING, ORGANIZATIONS & SOCIETY
THE ACCOUNTING JOURNAL
ACCOUNTING AND BUSINESS RESEARCH
ACCOUNTING FORUM
ACCOUNTING REVIEW
ACROSS THE BOARD (Formerly Conference Board Record)
ADHERENT
ADMINISTRATION AND SOCIETY
ADMINISTRATIVE MANAGEMENT
ADMINISTRATIVE SCIENCE QUARTERLY
ADVANCED MANAGEMENT JOURNAL
ADVANCES IN CONSUMER RESEARCH
ADVERTISING RESEARCH FOUNDATION PROCEEDINGS
AIIE TRANSACTIONS
AKRON BUSINESS AND ECONOMIC REVIEW
AMERICAN BUSINESS LAW JOURNAL
AMERICAN ECONOMIC REVIEW
AMERICAN MARKETING ASSN. COMBINED PROCEEDINGS
NALS OF ECONOMIC & SOCIAL
REMENT
LETIN

CREDIT & FINANCIAL MANAGEMENT
DECISION SCIENCES
DEFENSE SYSTEMS MANAGEMENT REVIEW
THE DIRECTOR
DIRECTORS & BOARDS
DISTRIBUTION WORLDWIDE
DUN & BRADSTREET REPORTS
DUN'S REVIEW
EASTERN FINANCE ASSOCIATION PROCEEDINGS
ECONOMIC JOURNAL
THE ECONOMIST
EMPLOYEE BENEFIT PLAN REVIEW
EMPLOYEE RELATIONS
EMPLOYEE RELATIONS LAW JOURNAL
ENGINEERING ECONOMIST
ESTATE PLANNING
EUROMONEY
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH
EUROPEAN JOURNAL OF MARKETING
EXECUTIVE
FEDERAL RESERVE BULLETIN
FINANCE
FINANCIAL ANALYSTS JOURNAL
FINANCIAL EXECUTIVE
FINANCIAL MANAGEMENT
FINANCIAL PLANNING TODAY
FINANCIAL REVIEW
FINANCIAL WORLD
FORBES
FORTUNE
FUTURIST
GAO REVIEW
GOVERNMENT ACCOUNTANTS JOURNAL
GOVERNMENT EXECUTIVE
GOVERNMENTAL FINANCE
GROUP AND ORGANIZATION STUDIES
HARVARD BUSINE
HUMAN RES

JOURNAL OF BUSINESS ADMINISTRATION
JOURNAL OF BUSINESS COMMUNICATION
JOURNAL OF BUSINESS FINANCE AND ACCOUNTING
JOURNAL OF BUSINESS RESEARCH
JOURNAL OF COLLECTIVE NEGOTIATIONS
JOURNAL OF COMMERCIAL BANK LENDING
JOURNAL OF COMMON MARKET STUDIES
JOURNAL OF CONSUMER AFFAIRS
JOURNAL OF CONSUMER RESEARCH
JOURNAL OF CONSUMER CREDIT MANAGEMENT
JOURNAL OF CONTEMPORARY BUSINESS
JOURNAL OF CORPORATE TAXATION
JOURNAL OF ECONOMICS AND BUSINESS
JOURNAL OF ECONOMIC ISSUES
JOURNAL OF ENTERPRISE MANAGEMENT
JOURNAL OF ENVIRONMENTAL ECONOMICS & MANAGEMENT
JOURNAL OF EUROPEAN INDUSTRIAL TRAINING
JOURNAL OF FINANCE
JOURNAL OF FINANCIAL AND QUANTATIVE ANALYSIS
JOURNAL OF FINANCIAL ECONOMICS
JOURNAL OF GENERAL MANAGEMENT
JOURNAL OF HUMAN RESOURCES
JOURNAL OF INDUSTRIAL ECONOMICS
JOURNAL OF INTERNATIONAL BUSINESS STUDIES
JOURNAL OF MANAGEMENT
JOURNAL OF MANAGEME
JOURNAL OF MARKETIN
JOURNAL OF MARKET
JOURNAL OF MONEY AND BANKING
AL OF THE

The database user has several options for the output, depending on the individual system. All references may be printed on the computer screen for immediate access or printed out at the source and mailed to the user. The user may specify bibliographic information only or ask for an annotation for each reference.

"Computerized libraries" such as the Online Computer Library Center in Columbus, Ohio, makes information retrieval much easier than doing a manual search of the library's card catalog. In the OCLC, Inc., system, a maximum of nine characters from the subject, title, and/or author are typed on the computer terminal; the computer searches the card catalog and prints out the number of references available, the names of the first ten books, the name of the author, and the copyright date. If none of those listed look promising, the user may request the printing of another ten items. If any title does look promising, the user asks for more information; the computer supplies the name of the publisher, where the book is housed, availability (whether it is out of the library, on reserve, or missing), and reference number.

Information storage and retrieval involved in videotext and teletext systems are available in experimental form in many parts of the United States, Canada, and in some European countries as Great Britian and France (see earlier figure). Videotext standards are used in Canada and the United States for the most part. They involve two-way, interactive communications between television users and computers via coaxial cable. They offer information services to homes and businesses and may include graphics and textual display features needed by advertisers.

Teletext standards followed in European countries involve only one-way transmission of information over broadcast frequencies; they do not typically include the two-way, interactive capability.

Regardless of the videotext and teletext standards, both systems involve computerized databases of information such as news items for electronic newspapers (including all news reported but not necessarily printed in today's newspapers), advertising (Sears and Roebuck's catalog in an experiment in Washington, D.C., and Cincinnati using videodiscs and the customer's home television screen), and telephone directories (that supply the name of the merchant handling specific products and even giving the address of those in the same geographic area), to name a few.

Companies such as CBS, Inc., and American Telephone and Telegraph Company are conducting free experiments in the videotext area. Some of the more widely known interactive computer services include the four used in this project and the Dow Jones Stock as well as The Source and CompuServe, both of which are sellers of information services.

Some firms, such as CompuServe, Inc., are selling computer memory to owners of microcomputers who want to have greater electronic filing capacity that is available on their own equipment. CompuServe, Inc., offers both computer timesharing, information services, and access to various databanks.

Encyclopedias are a form of information storage on paper. Recently, Arete Publishing Company, publisher of ACADEMIC AMERICAN ENCYCLOPEDIA, put its entire 10-million-word contents on computer tape. Then they conducted an experiment with 200 participants in Columbus, Ohio, who used modified home television sets to retrieve information. Other publishers are contracting with various news retrieval services for use of their encyclopedias in electronic form.

The Columbus test participants commented on the lack of sound while reading from the TV screen; consequently, sound such as bird calls or even speeches by Winston Churchill, for example, may be incorporated in future tests. Source Telecomputing Corporation of McLean, Virginia, is considering the use of the Bible on electronic systems, also.

COMPUTER GRAPHICS

Computer graphics functions have applications in many areas; namely, mechanical design (CAD/CAM), electronic design, business graphics, drafting and cartography, control and scientific areas, animation and art, and others. The expected market share by 1985 is judged to be highest in the CAD/CAM area while the greatest growth in applications between now and 1985 lies in the business area.

BUSINESS GRAPHICS applications have been relatively low in usage among small businesses; yet they are increasing in all types of usage within business. The market share of computer graphics is expected to increase to over 50 percent in the business area within the next five years.

Of the 144 companies surveyed by International Data Corporation, 85 percent used business graphics for management presentations, 59 percent for financial planning, 45 percent for sales presentations, 37 percent for PERT/scheduling charts, 26 percent for product planning, 23 percent for forms generalization, 22 percent for sales targeting, 21 percent for inventory and production monitoring, and an additional 12 percent for portfolio analysis. Basically, about 60 percent of the applications were slated for decision making support for top and middle managers (COMPUTERWORLD, 2/23/81, p. 10).

CAD/CAM, two computerized aids involved in mechanical design, eliminate much tedious and routine work for draftsmen and engineers. CAD (Computer Aided Design) is basically the drafting and analyzing of designs (bridges, tools, auto parts, buildings, etc.) via computer graphics using a visual display computer screen. Drawings can be structured; changes can be made rapidly and can be eliminated just as rapidly. Drawings can be displayed in three dimensional form and can be rotated on the screen for checking by the viewer.

Computers are programmed to "test" the designs, subjecting them to electronically simulated temperature changes, mechanical stresses, and other conditions. The CAD aids in determining if all the parts in a model fit together. Also, the computer is used to program factory machines to produce the parts.

Graphic display of "tests" of equipment already constructed can pictorially present the results of test calculations that may summarize as much as 300 pages of computer printout.

Architectural plans, car designs, bridges, computer models, all are possible using computer graphics and software programming.

CAM (Computer Aided Manufacturing) forms the other half of manufacturing applications involving the computer. That is, the computer is used to control production machines in many ways. For example, cutting machines (and others) are controlled by microprocessors; robots are programmed and reprogrammed to perform a variety of routine industrial tasks.

Computers are used to produce more computers. In fact, silicon chips are turned into computers using the computer to control the actual etching of the circuits on the chip.

DRAFTING AND CARTOGRAPHY APPLICATIONS are much easier using computer graphics. Drafting involves detailed drawings that often need some minor change; when the computer is used for such graphics, the drawings can be changed easily while also maintaining the original version.

Some cartography applications involve using computers and video aerial photographs for collection and analysis of digital data. Much more complex and much more accurate maps can be drawn from these analyses; the maps can be developed in much less time, also.

Computer graphics are used in CONTROL AND SCIENTIFIC SETTINGS to pictorially display production line data in charts, line drawings, and other forms. The computer records data but, even more important, the computer may actually control the input of chemicals into the manufacturing process in some instances.

Computer graphics are used to provide ANIMATION and are used in various ways in CREATING ART. Computer graphics, either through video camera input or by software programming, are now widely used in video production services for the film and television producers. Some of the applications include logo design; animation of images with complex patterning, zooms, and rotations; sequential animation for slide presentation; and scrolling of artwork designs to create moods. In fact, much of the advertising on television uses digital image productions for special effects.

ANIMATED SIMULATION of landscapes is another area that uses computer graphics, an area led by Charles Csuri, professor of computer science information and art education at Ohio State University. Three dimensional items such as trees, buildings, hills, and streets are used to improve the realism of present-day flight simulators for training pilots. The amount of detailed programming to simulate a tree is enormous; thus, huge data banks of graphics are built for future use. Imagine designing the various types and colors of tree leaves for all seasons, arranging them on different shaped trees of various sizes, simulating their positions in a high wind, or after a big snowstorm!

Computer animations are involved in many of the 1970s motion films requiring special effects including creatures from other planets and traveling in space.

Artists use computers to design paintings and statues. By simulating groups of objects on the computer screen, the artist can manipulate them to determine balance, coloring, and unity without developing multiple sketches. Sculptors design three dimensional versions of statues on the computer; then they rotate the image to determine the best form in terms of mass, plane, shape, volume, edges, shadow, and reflected light.

One sculptor combines computer graphics with information about the aging process to produce pictures of individuals that illustrate the effects of age on that individual.

Computer animation has been applied to games in recent years; both the speed of the computer and the interest instilled by animation and color have contributed to their success. Will educators use these same tactics to make learning more interesting? more effective?

Even though computer graphics applications are increasing, problems do exist that restrict wider use:

1) User-friendly software is not widely available.

2) Data in mainframe computers are not always in a form that can be manipulated easily by the available graphics software.

3) Little or no capacity is available to store charts with the ability to continually manipulate, update, and interpret data in different ways.

4) Difficulty of merging data from various files to build charts with varying difficulty levels.

5) Some difficulty remains in transferring graphics from the computer terminal to a "usable" format, such as paper, transparency, and printer.

6) The recent emergence of color capability presents new problems.

Computer graphics has many applications today, and more appear to be emerging each day. This area promises to be an extremely important one in the future.

VOICE SYNTHESIS TECHNOLOGY

Researchers have experimented for a number of years with voice synthesis in attempts to develop both effective speech recognition and speech output capabilities using the computer.

SPEECH OUTPUT. Although speech output is difficult to program on the computer, experimenters have had more success with it than with speech recognition by the computer. Voice recordings can be played upon signal from the computer. Speech synthesizers "manufacture" speech by (a) putting together sounds or phonemes (the smallest slice of a word) or (b) text-to-speech through conversion of alphanumeric characters to speech. The phoneme approach produces an unnatural speech which is difficult to understand by the untrained person.

Speech output is possible through a $3 silicon chip that can recite a vocabulary of 200 words. "Talking" calculators and foreign language translators are two examples of speech output applications.

Speech output via the computer is also used in telephone order entry systems, telephone access systems, reading machines and terminals for the blind, communicators for the verbally impaired, and computerized dispatching. They are found in the area of electronic entertainment in talking card games, chess games, and even video games.

In the telephone order entry systems, the computer is combined with a 12-button, touch-tone telephone, and a Port-a-Tone keypad. The customer keys in the order on the touch-tone telephone and each step is verified verbally by the computer before the caller goes on to the next step. The customer is informed immediately if an invalid product code has been entered or if any item is out of stock. Order entry is speeded up because there is no need to retype the order or the invoice and billing; there are fewer errors and customers know immediately if merchandise is not available.

Machines of all types are beginning to talk to users; cars inform the driver verbally when gasoline or service is needed; vending machines announce when they are not working or if the customer did not insert enough money; a computer announces the new telephone number if a caller dials a number that has been changed; and clocks announce the time.

The OCR scanner technology has been combined with voice synthesizers to "read" to the blind; point-of-sale terminals in grocery stores, for example, announce prices as they read the magnetic bar codes on each item.

Speech output from computers may aid nonreaders in coping with information as well as aid those readers who are saturated with visual confusion.

SPEECH RECOGNITION. Speech recognition (vocal input) by the computer is a more complex problem. The computer must recognize words and sounds regardless of regional accents, mispronounciations, speech defects, and other speech impediments. Further complications are inherent in the English language syntax and word spellings. Words such as "there" and "their" have the same pronounciation, for example.

Voice input devices can recognize and react to a relatively small number of words when they are pronounced separately. They have mainly been developed to aid the handicapped person who has little or no physical movement.

Continuous speech, however, is more difficult for the computer to recognize. In 1980 an IBM computer transcribed a speech based on a 1,000 word vocabulary and read at a normal speaking pace with approximately 91 percent accuracy (COMPUTERWORLD, 6/9/80, p. 51).

Xerox, Wang, and Matsushita are experimenting with speech recognition, as are others. Voice-activated typewriters from one or more of the many competitors in this area may appear as early as 1983 (WORD PROCESSING REPORT, 10/1/80, no page).

Voice input technology is in its infancy stage but it may have an increasingly important role in the computerized Year 2000.

SUMMARY

The technology related to communications has changed rapidly in recent years; in fact, it has changed so fast that there is probably a 20-year gap between the technology and its applications in widespread use. At the same time technology continues to progress at a rapid rate. The Year 2000 promises to be an extremely exciting beginning for the twenty-first century.

CHAPTER III

CRITICAL ISSUES AND SOCIETAL EFFECTS

Communications technology is shrinking the distance between widely separated places. Computer power and satellite linkages are providing new services in more quantity to more people than ever before. The effect on society--and various segments of it--may be both positive and negative, however.

The dramatic changes in communications technology in recent years are miniscule when compared with those expected by the Year 2000. These technologies have far-reaching social implications. The associated policy issues may be grouped into three categories:

Issues regarding technology and its social control through regulation

Issues related to industrial applications of technology, such as electronic mail and electronic funds transfer systems

Issues concerning access to information and the general effect on society

The computer-integrated communications systems are gigantic and they are expanding rapidly. The United States (as well as other highly developed countries) is so large and so complex a nation and so involved in international concerns that it can no longer be run with pencils and notepads. Yet the collision between legitimate need of public and private institutions for information about people and the inherent rights and privileges of the individual must be avoided. Hence, there is an ever-increasing concern about the conflict of computers and individual privacy.

The societal effect of the computer is a broad topic; hence, only a few selected factors will be discussed here. Generally speaking, these factors are directly related to one or more of the technologies under consideration. These factors include:

Electronics and consumer finances
Health issues related to terminals
Freedom of information and right to privacy
Computer vulnerability
Applications and gadgetry
Transborder data flow

The glut of information may be mind-boggling for much of society. Experts estimate that early in the twenty-first century, computers will have access to over 100 trillion words. And these speedy computers will fit in a briefcase and be able to read, digest, and present conclusions to 100,000 books a second.

ELECTRONICS AND CONSUMER FINANCE

The electronics age, involving highly computerized communications technologies, affects consumers in various financial ways; namely, via credit cards, "memory" cards, electronic shopping, electronic funds transfer systems, and electronic retailing techniques. Some of these are rather widely accepted now while others are offered only in experimental markets at the present time.

THE CREDIT CARD

The current U.S. credit card was issued a number of years ago as the first step in a "cashless society'; yet only 3 percent of all transactions in 1980 involved the use of a credit card. Furthermore, credit transactions created voluminous stacks of paper and actually resulted in higher consumer costs in the long run. Bad checks and stolen credit cards contributed to higher costs, also.

In order to reduce losses from stolen credit cards and to prevent purchasers from exceeding credit ratings, merchants call the issuing bank for verbal approval of all purchases over $50 when the customer attempts to use a credit card. This procedure is tedious, expensive, and time consuming for both the seller and the purchaser.

Therefore, the day of "floating money" is about to disappear. The customer's practice of sending a check through the mail or giving one to a merchant with the expectation that it will not reach the bank for several days--a floating loan, in fact--has virtually been eliminated due to electronic funds transfers between banks. Also, the "no-interest" loan or floating money that accompanies charge purchases (payment can be postponed almost 60 days if the customer times the purchase and payment carefully) will disappear.

Several new developments related to consumer finance have been developed recently; others are in the experimental stage now and will be in place in the next few years.

General Telephone Company offers merchants and credit organizations a Micro-Fone, a computer terminal linked automatically to a telephone line. Credit cards are inserted at the time of purchase at a store; the magnetic strip on the back of the card is read by the machine and the credit verification is available in approximately 10 seconds. Time spent in dialing the agency and waiting for oral vertification is eliminated.

In 1981 MasterCard issued an "affluent" credit card having a minimum credit line of $5,000 and with no present spending limits, thus eliminating the time-consuming task of checking credit ratings by phone. The card is granted to those with incomes over $30,000 and is honored at most places that the regular MasterCard is accepted. The nearest competition is the American Express "gold card" with a minimum credit line of $2,000 which is usable at a limited number of establisments (WALL STREET JOURNAL, 3/9/81, p. 30).

The MasterCard II, another development, looks like a credit card but acts like a check; the purchase is deducted directly from the customer's bank account as the merchant runs the card through a special machine at the time of purchase.

Today's credit cards have magnetic strips that hold information. This magentic strip also allows the user to use a computer terminal in the 24-hour banker. A thief with some electronic knowledge and an inexpensive reader can read these magnetic strips. Also, the magnetic strip can be damaged accidentally as any magnet can erase or alter the information.

The machines for reading the chip cards cost only $100, much less than a terminal and on-line computer time. Yet by 1981 on-line terminal banking was widely used in the United States; thus banks and merchants may find it uneconomical to switch to the memory card system in the future.

In recent years the problem of stolen or lost credit cards triggered the growth of credit card "listing" services. For an annual fee, a person may list all of his/her credit cards; such companies provide services such as credit card registration, toll-free numbers to call if cards are stolen or lost, notification of all card issuers within 24 hours, automatic requests for replacement cards, theft deterrent labels, change of address notification, and emergency cash and airline tickets for members who are away from home when cards are lost or stolen. Many household insurance policies now provide coverage for lost or stolen credit cards for a small fee.

However, questions about the SECURITY OF INFORMATION within the credit card listing service itself may also be a problem if the company has unscrupulous workers or if outside callers attempt to break the codes.

Consumers nationwide may be able to access cash and travelers' checks at any automated bank teller machine at any financial institution using Visa and MasterCard plus PIN (a Personal Identification Number) at those banks using the Electronic Funds Transfer System (MIS WEEK, 10/28/81, p. 29). Eventually the automated teller machines may provide access to more than one bank from remote locations.

PRIVACY OF INFORMATION is a major concern within the consumer finance area. Collection of data to determine credit ratings and disclosure of that information to subscribers and/or governmental organizations without the knowledge or consent of the individual is and will continue to be a serious concern. Policies and legal regulations are needed to ensure equity in granting credit to all regardless of race, sex, and/or nationality. At the same time the need for such types of information by lending institutions, businesses and merchants, and the government must be balanced against the rights of individuals; consumer safeguards must be maintained, too.

THE "MEMORY" CARD

The new "smart" card--the "memory" card--may be the answer. In effect, no credit is available in the current sense of the word. There are two versions of the memory card in existence today. In the United States the memory card will carry "credit rating" information and "accounts" while the European memory card will actually carry "electronic cash."

In the United States the customer's memory card will be inserted into the store's reading machine (which is connected directly to the bank) and the money is transferred electronically at that time. The memory card actually holds a computer chip and may carry 20-30 accounts in its memory. The user needs only the one card. When a transaction is made, it is recorded on the card; the holder of the card can insert it into a home terminal, a store's terminal, or a bank terminal and can see that the transaction was made. Problems do exist with this new technology. The memory card can carry only 200 transactions at this time and then a new card is needed--at an additional cost. The chip cannot be made larger or the card becomes too thick to be inserted in present reading machines.

A different type of "memory" card is used in other countries. The memory card (which has various other names such as "chip" card, "intelligent memory" card, or the "electronic checque book") is being pioneered in Europe, primarily in France. The French version is called "Innovatron" and is issued by CII Honeywell Bull, Inc. It contains a uniquely designed microprocessor chip imbedded in a plastic card. When this card is inserted in an inexpensive transaction machine at the bank, the money is electronically recorded on it (in contrast to the card containing only credit rating information as used in the United States). However, the money on the memoy card does not collect interest as it does when the money is in the bank.When the card is used to make a purchase in a store, the money is transferred from the customer's card to the merchant's.

Safety measures built into the Innovatron system include the fact that the card (1) cannot be duplicated or reproduced (it disintegrates if an attempt is made); (2) is not subject to forgery because it is a unique component without parts; (3) is inalterable--resists time, weather, and voluntary attempts to modify it; and (4) is inviolable--needs a specific reading device and/or knowledge of the PIN (key). This reference PIN makes the card self-defensive; for example, it permits only so many errors in entering the card and then the card destroys itself. In the future these 8K-memory cards may include a fingerprint or voiceprint for identification purposes.

Memory cards for other uses may be much more viable and practical as there is no existing system. These uses may include memory cards used as health care and medical history cards, car maintenance records, military identification in place of dog tags, rationing cards for gasoline if needed, season tickets to sports events or fine arts performances, library cards, passports, telephone call cards, and personal employment records.

Electronic cards may be used as "keys" (also called "chip-keys"); those offered by Datakey, Inc., have an integrated circuit in the plastic. These keys, with part of a computer program on them, are used to control access to computer rooms and the computer itself; they are considered more secure than the traditional password systems.

The chip-key is also used as a hotel room key because this type of key can be altered at the front desk without communicating with the computer as is the case with present wired electronic lock systems.

Car rental firms are also considering the chip-key because its memory can hold more customer data than any conventional credit card.

ELECTRONIC SHOPPING

The communication link between cable television, telecommunications, telephones, and computers makes "electronic shopping" possible from one's home or business. Electronic shopping is initiated using two different approaches: (1) customer initiation or (2) seller initiation.

In the customer-initiated approach the customer phones the seller and tells them vocally or by typing on the home computer the type of product desired. The seller then calls up from the computer files both pictures and descriptions of several models. These models are displayed on the customer's cable television set; the models may be rotated so that the customer sees all sides and a salesperson may demonstrate the use of the product. When the customer has made a decision, he/she keys in the number of the item, the quantity wanted, and his/her bank account number; the computer (via the cable television's computer) would already have the customer's name and address.

In the seller-initiated approach, advertisements appear on cable television much as "spot" commercials do now; however, they may be on a separate "sales" channel. Catalog numbers and a telephone number will be included so that the customer can contact the seller and order the product in somewhat the same manner as explained above.

The French have developed an electronic shopping system that combines an electronic telephone directory terminal and a one-way video system that is called Teletext. Electronic message service will be included so that users can compose their own messages and send letters and graphics for a fee of about 12 1/2 cents for 5 minutes of "connect" time. The Teletext system offers an electronic shopping service using the telephone company and La Radoute, the largest mail-order retailer in France. The delivery system is unique as La Redoute deposits merchandise any place in France overnight in special microcomputer-controlled lockers in metro (subway) and railway stations. The customer uses Teletext to find out the locker number in which the merchandise has been deposited and uses his/her La Redoute credit card to open the locker (COMPUTERWORLD, 10/20/81, p. 1, 4).

ELECTRONIC FUNDS TRANSFER SYSTEM (EFT)

The EFT system has existed in the banking industry itself for a number of years, but it involved transfers from bank to bank. Extensions of this system to customers has occurred in recent years and offers various features; namely,

24-hour bank service via automated teller machines

Pre-authorized transfers especially in three areas--payrolls, utility bills, and social security payments

Pre-authorized rent payments in apartment complexes

As the use of electronic shopping and "memory" cards flourishes, EFT applications may grow until society does indeed approach the "cashless" level.

Concern is often expressed by consumers and professional bankers about the EFT system, however. Most concerns deal with privacy of information, "trust" in the system that it will not make errors, and the problem of security. Many people express a need for "tangible evidence" in the form of paper that a transaction has taken place. For example, some banks attempted to reduce costs by not returning cancelled checks to customers; most bank customers have opposed this option so far even though they have the option of requesting copies of essential checks.

The question of legal responsibility in case of error or criminal activity within the EFt system is still to be resolved, also.

A personal identification device called QSIGN was recently introduced by Micropad, Inc., for use with electronic funds transfers and security area access. The unit compares written signatures with reference data stored in a computer or on a magnetic card; in other words, it compares signatures. It may also be used for computer data base and file access violations and authorizations for virtually any computer action.

ELECTRONIC RETAILING TECHNIQUES

A decade or more ago UPC (Universal Product Code) scanners were introduced in grocery stores with predictions that they would be in widespared use before 1980. However, installation costs, service and reliability problems, and customer nonacceptance forestalled such widespread use. Recently a new generation of such scanners was developed, and an upsurge in their use has occurred. The UPC scanners are more accurate and more dependable. Furthermore, printers have been attached so that customers receive a detailed printout by brand name or product name; the price for each item is also recorded.

Nearly all large department stores, supermarkets, and fast-food stores have converted to electronic cash registers and/or POS (point-of-sale) terminals. Even the smaller retail stores are making the conversion since many wholesalers offer automatic inventory replacement based on the computer capabilities built into the POS terminal. These terminals aid in maintaining inventory records, analyzing cash flow and sales, and processing of charge account purchases.

The POS terminal is expected to be combined with EFT (electronic funds transfer) systems by 1990. Micropad's QSIGN device (described earlier) may be a very important part of the POS/EFT process in order to check on authorized signatures.

Two additional features are available now but they may or may not receive widespread acceptance:

"Positalker" (National Cash Register) terminal, which is equipped to read prices aloud as they are scanned

A holigraphic scanner (IBM) that can read product codes within a 180-degree field to make checkout time faster as the clerks do not need to take time to turn the products over so that the scanner can read the UPC graph.

The UPC scanners are currently in use in the Atlanta airport to read the destination for each piece of baggage. The computer sorts the luggage by special tags that the airline representatives sticks to each piece as it is checked in.

HEALTH ISSUES

Three major health issues are directly related to the use of computers terminals, microcomputers, and word processors:

Eyestrain, headaches, and possible radiation effects

Ergonomics, the designing of equipment for the user's health and comfort

Stress

Charges made by workers that VDTs (visual display terminals) cause cataracts and other health problems due to radiation have not been substantiated in current research studies. Problems associated with eyestrain and headaches have produced experimental research for redesigning both the VDTs and furniture. Working conditions have also been reviewed and changed in some cases. Keyboards are detachable so that the operator does not need to stare directly at the screen; different colors and different levels of brightness and contrast are being tried to achieve better readability.

Ergonomics experts have concentrated on designing everything from the VDT and keyboard to the furniture--tables, desks, swivel stands, and chairs. Lighting, vibrations, and noise levels are undergoing re-evaluation in relation to computers, word processors, printers, and other electronic equipment.

Stress on the job includes work pressure, conflicts with supervisors, and the inability to alter one's own routines. Consequently, redesign of jobs is receiving greater attention.

A number of topics concerning human considerations have been identified in relation to on-line computer terminals and word processing centers: (1) user acceptance, (2) time factors, (3) hardware factors, (4) length of communications, (5) system sensitivity, (6) errors and error messages, and (7) symbiosis (working together in close association). User acceptance factors are concerned with (a) pressure (the fast feedback leaves some workers with the fear that they should respond equally fast), (b) a "peephole" effect from seeing only a small part of the whole, and (c) a "fishbowl" effect from working at terminals where others can view the work.

THE WIRED HOME

Today's home is relatively simple in its use of electronics; however, the potential for a highly sophisticated electronic home exists today. Some homeowners have installed several microprocessors for special applications but few have installed "complete" systems.

The "electronic" home provides opportunities for convenience in personal living; but more important, it offers much more opportunity for educational and career applications. Many of these are described in detail by James Martin in TELEMATICS SOCIETY: A CHALLENGE FOR TOMORROW (Prentice-Hall, Inc., 1981, which was first published under the title THE WIRED SOCIETY in 1978). Alvin Toffler wrote about the "electronic cottage" from

HOMES AND TELECOMMUNICATIONS

Just as the telephone connected the home to businesses, schools, governmental offices, and other homes, the 1980s home is connected to telecommunications via cable television. In the 1940s few homes had television; by 1980 nearly 100 percent of the 100,000,000 homes in the United States had television. By 1980 almost 50 percent of the homes in the nation had cable television; by 1990 nearly 100 percent are expected to be "wired" to cable television (Martin, James. FUTURE DEVELOPMENTS IN TELECOMMUNICATIONS, Second Edition. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979, p. 136).

Although the telephone system is an interactive, two-way communication system, it carries only voice transmissions and digital data. Its use for video transmissions is not feasible (see Chapter 2). However, cable television systems include channels of transmission capable of handling all types of messages--voice, video, digital and analog. Cable television is controlled by computer and thus can be an interactive, two-way system involving voice, video, and both digital and analog data. It has great potential for many innovative uses.

PERSONAL COMPUTERS

In order for the cable television to work as a two-way, interactive system, the homeowner must have a input device for entering data and responding to the sender. Most often, this device will be a special piece of equipment supplied by the cable television station with a series of buttons. However, a personal computer serves as a much more flexible input device and as a storage device for collecting data from outside sources.

The personal computer (a microcomputer) first appeared in 1975 and was geared to the electronics hobbyists. However, by 1980 many of the microcomputer manufacturers were gearing their machines to the "average" person, the professional person, the homeowner, and the small businessman.

Dataquest Inc. predicts that the $800 million in sales of personal computers in 1980 will rise to over $4 billion in sales by 1985 (BUSINESS WEEK, 9/28/81, p. 78); these figures include all sales to business, technical, education, home, and hobby areas.

Thus, more homes will have access to more information than ever before, will be able to support more of the electronic control devices that are currently appearing on the market, and will have a point of contact to consumer and governmental resources, educational facilities, and businesses.

TYPES OF SERVICES AND PRODUCTS

The home with its computer, cable television, and telephone system will be able to access many types of services and products (adapted from Martin, James. TELEMATICS SOCIETY: A CHALLENGE FOR TOMORROW. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1981, pp. 124-127), including

PASSIVE ENTERTAINMENT

Radio
Many television channels
Pay television
Dial-up music/sound library

PEOPLE-TO-PEOPLE COMMUNICATIONS

Telephone
Telephone answering service
Voicegram service
Message sending service
Telemedical services
Psychiatric consultation
Access to elected officials

INTERACTIVE TELEVISION (two-way communications between home and source)

Interactive educational programs
Interactive television games
Quiz shows (such as "The Magic Touch" show in Columbus, Ohio)
Advertising and sales

Television ratings
Public opinion polls
Audience-response television
Public reaction to political speeches and issues
Bidding for merchandise on televised auctions
Betting on horse races and other sports

STILL-PICTURE INTERACTION

Computer-assisted instruction
Shopping
Catalog displays
Advertising and ordering
Consumer reports
Entertainment guide, city information, traveling advice and directions
Boating and fishing information
Sports reports
Weather forecasts
Hobby information
Book and literature reviews
Book library service
Encyclopedia
Computer dating
Real estate sales

MONITORING

Fire alarms on line to fire service
Burglar alarms on line to police
Remote control of heating and air conditioning
Remote control of cooker and stove
Water, gas, and electricty meter reading
Television audience counting

TELEPHONE VOICE ANSWERBACK

Stock market information
Weather reports
Sports information
Banking
Medical diagnosis
Electronic voting

HOME PRINTER

Electronic delivery of newspaper/magazines
Customized news service
Stock market ticker
Electronic mail
Message delivery
Text editing; report preparation
Secretarial assistance
Customized advertising

Consumer guidance
Information retrieval
Obtaining trasnportation schedules, travel advice, and maps

COMPUTER TERMINALS

Income tax preparation
Recording tax information
Banking
Domestic accounting
Entertainment and sports reservations
Restaurant reservations
Computation
Investment comparison and analysis
Investment monitoring
Work at home
Access to company files
Shopping information, price lists, and comparisons
Job searching
Vocational counseling
Obtaining insurance
Obtaining licenses
Medicare claims
Emergency medical information
Yellow Pages
Dictionary, glossary, thesaurus
Address records
Diary, appointments and reminders
Message sending
Dialogues with other homes
Christmas card and invitation lists
Housing, welfare, health, and social information

Many of these services are available to the homeowner today. The stock market information is available through commercial sources. Companies such as The Source and CompuServe offer many of the others. In some cases, the service is available to the homeowner by simply buying a piece of relatively inexpensive electronic equipment. However, other services are still in the experimental stage, with a few only on the drawing board now. Many more types of services may be offered; the only limitation is creativity and the gap between it and the technological application.

COMPUTER MAGAZINES

One barometer of the increasing interest in computers, and especially the microcomputer for home use (as well as in small businesses), is the number of magazines that provide information about them. They include

COMPUTERWORLD
BYTE
DATAMATION
MINI-MICRO SYSTEMS
COMPUTER DECISIONS
COMPUTER SYSTEMS NEWS
INFORMATION SYSTEMS NEWS
DATA COMMUNICATIONS
COMPUTER BUSINESS NEWS
INFOWORLD
THE COMPUTING TEACHER
CREATIVE COMPUTING
DESKTOP COMPUTING
ELECTRONIC LEARNING
COMPUTE
EDUCATIONAL COMPUTER
PERSONAL COMPUTING
RECREATIONAL COMPUTING

Other publications are published for specific brands of machines or for specific software programs (SATN for on-going support of VisiCalc, a program from Software Arts, Inc.). General publications, such as TIME, FAMILY CIRCLE, and NEWSWEEK, carry news about computers almost daily. Almost every specialty and trade magazine carries at least one article in each issue that deals with computers or some phase of electronic communications.

Thus, the homeowner reads about computers almost daily and at the same time acquires career-related information from various sources. Students at elementary, secondary, and collegiate levels are learning about the computer and using it in ever-increasing numbers.

WORKING AT HOME

One phenomenon has occurred as homeowners acquired microcomputers--some workers can now perform their work at home. In fact, some companies have experimented by providing workers with the microcomputers and with permission to work at home.

These alternate work stations provide some unique advantages: (1) The worker has more time and saves money by not commuting. (2) The worker has more flexibility about when the work is performed (in some cases). (3) They permit handicapped individuals to work without physical travel. (4) Specialists can work wherever they are (perhaps in California) and work for firms in other geographic (perhaps New York) locations, especially important when some types of workers are difficult to find. (5) They make part-time work more profitable for the worker.

There are some disadvantages also in the alternate work stations of working at home: (1) Managers have difficulty in supervising workers at home. (2) It is difficult to communicate about complex, highly detailed tasks. (3) The lack of personal contact with other workers causes loneliness if one works by oneself all the time. (4) Some managers have failed to accept the concept and some workers feel that those who are at home are "not really working."

Nevertheless, some companies have experienced success with programmers and with word processing operators, for example. Other applications are likely to be successful in the future when attitudes change and when such experiments become more prevalent.

ELECTRONIC LEARNING

The same concept of working at home may be applied to "learning at home." This topic will be discussed in detail later.

COMPUTERS AND PRIVACY

Individual rights must be balanced with societal needs; individuals have a right to privacy and to freedom of information. However, the computer integrates telephones, telecommunications, electronic files, word processors, databanks, company records, governmental records, and even criminal records.

Therefore, a series of policy questions concerning privacy, security, and confidentiality must be considered--a task that is very complex. Only the questions will be identified here.

There is a basic difference between the concepts of "privacy," "security," and "confidentiality." These differences must be considered when policy decisions are made.

Privacy involves the belief that the individual has a right to determine how information about oneself is used or communicated to others; that such information is properly protected against misuse; that it is protected against unwelcome, and/or unfair use; and that there is no excessive collection or dissemination of such data.

Security involves protection in a computer-based system (including the hardware, personnel, and data) against deliberate or accidental damage or against giving the data to an unauthorized person(s).

Confidentiality implies that sensitive data be protected against theft or misuse and that it be disseminated only to duly authorized persons or those who have a right to know.

OWNERSHIP OF DATA AND INFORMATION

Policy decisions must be made about the ownership of information. When data gets into the computer, who owns it? The individual identified in the information? the person or company supplying the information? the owner of the computer?

Who owns the data (such as entertainment shows beamed over satellites) that flows across borders (referred to as "transborder data flow")? Is it owned by the originator who beams it to the satellite? Is it free to anyone who has the equipment and resources to recapture the communication? Does it belong to the government of the land over which it travels? Does it belong to the intended purchaser?

Who owns the messages sent over electronic mail systems? the originator? the sending system? the receiver? Who owns the data and information that originates from POS terminal transactions? Does a department store, for example, own the data about customer credit transactions, or does the customer maintain the right to such information? Does the store maintain ownership of the electronic data concerning inventory records that arise from POS terminals and includes software for automatically reordering merchandise?

LARGE SCALE TRACKING SYSTEMS

Policy decisions about large scale tracking systems and individual rights have favored the latter in recent years. "Matching" of data from one federal database to another has been prohibited; however, societal needs and governmental rights are beginning to gain grounds. For example, should welfare payments to families with missing parents (fathers, for the most part) be matched to social security numbers and employers' reports in an effort to make the missing parent support his/her family? Should bank accounts be matched to income tax reports to ferret out offenders? Should credit ratings be matched to income tax reports? Should welfare payment rolls be matched to social security records, income tax statements, federal payrolls, and bank account records?

POLITICAL DECEPTION BY COMPUTER

Should politicians be able to disclose only parts of their beliefs based on a computerized analysis of the audience to which they are talking (based on census tract data, city directory data, established sociopolitical categories--and even cable television analysis of viewing patterns? If electronic voting from the home becomes a reality, who controls the household-by-household analysis of voting results?

CRIMINAL JUSTICE

A balance between individual rights and societal needs is needed in the criminal justice system. Questions arise about who has access to data, removal of unfair or unsubstantiated information, and the way data is collected about and from suspects.

AREAS OF CONCERN

Perhaps a series of questions will best illustrate the areas of concerns and some suggested solutions. The known policy considerations are complex, and others are yet to be discovered:

> Should databank operators be licensed at the federal/state level?
>
> How should a balance be maintained in a total tracking system (following an individual from birth to death) between individual rights and societal needs?
>
> What ways and policies are available to purge, seal, and retain information?
>
> Is there a need for a universal identification such as the Social Security number? What are the inherent dangers and how can they be handled?
>
> How will errors be handled?
>
> Who owns the data and information?

The 1970s era ushered in some guidelines for balancing societal and individual needs; by 1980 some of the legislated actions appeared to favor individual rights as more and more frauds in the welfare and social security systems (especially fathers who fail to pay family support and the increasing numbers of fraudulent welfare payments) were discovered.

Truth verification technology such as polygraphs and voice stress analyzers has been developed, but their adoption has been slow in criminal justice systems and other areas for many reasons.

COMPUTER VULNERABILITY

Computers are vulnerable in three ways: (a) breakdowns, (b) criminal acts, and (c) security. Each way has a definite effect on business and society.

BREAKDOWNS

Malfunctions or unreliable operations are infrequent for the most part; but when they occur, they are highly disruptive and expensvie. Therefore, computer users must maintain a "backup" system. Compter designers continue to work to devise fail-safe systems in the meantime.

CRIME

The potential for computer crime has expanded greatly, with the average dollar loss over twenty times greater in 1980 than in 1970. In fact, experts estimate that only one in 100 computer-related crimes are ever detected, that only three in 20 of these are reported, and that only one in 33 of those reported are successfully prosecuted. Therefore, only one in 22,000 computer-involved criminal acts are successfully prosecuted. The FBI reported in 1979 that embezzlements without the aid of a computer averaged $23,000 while those that were computer-assisted averaged $430,000 (COMPUTERWORLD, 12/8/80, p. 5).

Business frauds are directly related to computers due to (a) low-cost personal computers, (b) soaring numbers of students and others who are learning how to use computers, and (c) the large number of employees who now can or will soon be able to access computers through remote terminals.

Illegal access to data transmission methods (such as telephone wires, microwaves, satellites) may involve stealing proprietory information, inserting fraudulent messages to transfer money from one bank account to another, and inserting fraudulent credit ratings.

Banks are not now insured against third-party wiretap frauds and therefore they have a huge potential risk for high losses in the EFT systems.

Employees are stealing valuable computer time for personal use--making track bets, playing games, and conducting personal business.

The typical computer criminal is probably a white-collar worker, a trusted individual who is intelligent, appears to be a hard worker, and is not directly involved in computer operations management, programming, or systems analysis (COMPUTERWORLD, 11/2/80, p. 21). He is most likely white and between the ages of 19 and 30, has no criminal record, and is more dedicated to his profession than his company, according to crime authorities (COMPUTERWORLD, 2/9/81, p. 24).

Several criminal electronic tricks already have special names and appear in COMPUTER CRIME CRIMINAL JUSTICE RESOURCE MANUAL, which was authorized by the U.S. Department of Justice:

> TROJAN HORSE: Slipping extra commands into a computer program; when it is run by someone else higher up, the instructions are automatically triggered.
>
> SUPERZAPPING: Penetrating a computer by activating its own emergency master program.
>
> SCAVENGING: Searching through stray data or garbage for clues that might unlock other secrets.
>
> PIGGYBACKING. Riding into a system after a legitimate user.

Other electronic tricks carry names such as "data diddling," "logic bombs," and "salami technique."

Some protections against computer crime do exist and others are emerging. Researchers in Florida are attempting to develop a computer-based OCR (Optical Character Recognition) techniques for identifying typewriters (printers) used in embezzlement, blackmail, and fraud. There are, however, over 2,000 typewriting fonts in existence.

There are a number of computer-related crimes that occur around computers, including such activities as:

> Moving to a competitor firm and taking the ex-employer's trade secrets
>
> Collecting welfare payments in two states or at two addresses in the same state
>
> Copying your employer's software and then going into one's own business
>
> Selling of one company's trade secrets to another
>
> Matching welfare recipients to the state's payroll

Breaching access to packet-switching networks and damaging the user's files (as two Canadian high school students did over DATAPAC)

Using large data files to spot consumers especially susceptible to unscrupulous sales pitches

Exploiting of consumers by financial service providers

Stealing a person's credit profile for charging merchandise

Selling of good "credit ratings" to those with poor ones

Embezzling large sums of money (Wells Fargo Bank case in early 1981)

SECURITY

Computer security (that is, its physical safety) has many facets, including (in order of importance according to Sullivan, COMPUTERWORLD, 12/11/80, p. 21) dishonest employees, fire damage, water damage, external attack, and destruction of files by employees who are fired.

Computer designers and users are struggling to devise ways to secure both the computer hardware and its use, especially its software programs and the data files. Different levels of protection are needed. The computer needs to be protected from casual entry by unskilled persons and/or skilled technicians. More important, it must have protection against accidental disclosure of "secure" information, against entry by persons who stand to gain financially, against well-equipped criminals, and against organizations with massive funds. Some common measures involving security are:

Physically protect computer rooms with guards, private locks, magnetic-card access systems, voice identifications, and/or thumbprint recognition.

Use software to restrict computer access and simplify computer audits.

Use hardware to encrypt or scramble data transmissions.

Develop secret passwords for computers and remote-access terminals to restrict access; after the person has access to the computer, limit the access to certain files and/or only to perform specific functions.

Separate functions (programmer not allowed access to files, for example).

Design auditing controls fitted to computers:

Cross check computer files with vendor-payment programs to determine if service or product was actually delivered.

Build in separation of employee duties.

Use audit trails back to individual making transaction.

Maintain a log on everyone who accesses each file.

Isolate individuals with above-average overtime payments.

Highlight an abnormal number of correction entries which often signal a computer fraud.

Develop emergency recovery plans--that is, backup computer facilities that can be leased in case a catastrophic event cripples the company's computer. Develop operational procedures that emphasize a balance of checks and counterchecks that are commonly used in accounting systems.

Good techniques are available now; however, some companies do not believe that it is necessary to incur the additional expense. As users and criminals become more knowledgable about computers, new and more sophisicated security procedures will be necessary.

SOFTWARE APPLICATIONS AND "GADGETRY"

Numerous applications of the computer and other communications technology have been cited throughout the previous sections; these applciations ranged from busines applications to scientific ones. Literally thousands of others have appeared in recent years; some have practical use while others are "gadgets" (a contrivance that may or may not be useful). Sometimes the "gadgets" have sparked the imagination of others and practical uses are developed. At any rate, a number of items are listed here--only time will tell whether they are useful or merely gadgets:

UPC-type codes stuck on baggage at an air terminal so that the computer can sort it for the correct flight.

EDUCATION USA NEWSLINE--a computer network to provide same-day news and information for educators at electronic speed (from EDUCATION USA) to aid in lobbying and for supporting teachers' strikes.

Bi-lingual computer terminals using Arabic symbols as well as English-type letters.

Electronic postage scales that are programmed to provide instant rate comparisons between postal service and UPS costs, to change rates when postage rates increase, and automatic recordkeeping of all postage spent.

Computerized cosmetic choices. Customers respond to multiple-choice questions posed by the computer about race, age, eyes, condition of hair and complexion, and preferences for clothing. The computer prints out on paper any one of 5,000 possible combinations for makeup according to clothing color preferences; it flashes pictures of how the customer might look if cosmetics were used as suggested.

Computers help coaches train athletes by analyzing tiny details of their performance using high-speed film of motions and then analyzing them by computer.

Voice recognition applications--

Tell the microwave oven what to do--how many minutes, what temperature.

Talk to the toaster and tell it how brown you want your toast.

Change radio frequencies by talking to the radio (for pilots whose hands are busy otherwise).

ECG analysis by the hospital computer to cut the time in half.

Computers, bar code readers, and CRT terminals used by librarians to keep track of books.

Robots used in all types of manufacturing to perform routine assembly tasks.

"SmartShelf," a system in which pressure-sensitive circuits are installed under ordinary industrial shelving to weigh what is in the warehouse; they convert the weight to number of units on the shelf and then display any inventory changes on the video screen of the computer which can then print out the inventory records.

"Typecorder" by Sony, an 8 1/2- by 11- by 1 1/2-inch electronic machine that weighs under 3 pounds and is a combination typewriter, dictation/transcription machine, text editor (with a one-line visual display), and communicator to the computer. The user may type up to 120 pages that can be recorded on the microcassette or 60 pages of oral dictation; all data can be printed out when the unit is plugged into the computer/printer, or it can be sent back to the central computer via the telephone.

Experimental robot with sensors that measures everything from one's temperature to one's strength or grip.

Electronic meter readers to send meter readings over the telephone lines and limit the number of meter readers.

"Ultraphone"--a pocket-sized, portable telephone that enables the user to go up to 10 miles away from the base station (in contrast to most portable telephone's limit of several hundred feet).

"PrivCode," a telephone attachment that intercepts all calls before the telephone rings. Through an electronic voice it asks the caller for his/her code number; if the code number is on a list of approved numbers, the telephone rings and the code is displayed on the terminal. If the number is not on the approved list, the telephone remains silent and the caller is connected to an answering machine.

Pressure-sensitive circuits and computers team up with the welcome mat on the front step. When callers ring the doorbell, they are weighed and examined for height by the computer; friends who have been programmed into the computer memory previously are then identified before the door is opened.

Customized information services to eliminate the information glut are available; viewers select precisely what information they want and then microprocessors inside radios, video screens, and news service printers (computerized) edit out all other data.

Computer-controlled engines on Cadillacs (experimental only) record the way the driver uses the car and stores the data; later the computer may tattle on the driver if some part of the warranty was violated.

Redistricting congressional districts done using computer maps and data--and the "what if" type of querying.

A "talking" Show and Tell microwave oven that displays recipes and the ingredients needed; it provides a printout, responds to verbal instructions, and announces in its own voice when a meal is completed. A built-in television will show how the recipe will look when done or let the user watch a favorite television show while the food is cooking.

Order airline tickets by touch--air travelers view a "Proteus" terminal that displays a map of the United States; the computer invites the traveler to point to the city where the trip will originate. Then the terminal asks the traveler to point to the destination city. A calendar appears on the screen and the traveler again points to the departure day; the terminal then displays all possible flight times. The traveler chooses one by pointing to it and then a ticket is printed.

The "invisible" modemphone--a telephone with a built-in, full-duplex modem.

A computerized cookbook for grocery shopping and meal planning.

Cars with

Chips to improve fuel economy and monitor the engine.

Electronic map display that points out the car's destination, gives instructions on the best route to follow, and notes the progress of the trip.

An automatic seat adjustment--when a different driver enters the car, he/she inserts a plastic card in the dashboard slot to adjust the seats, air conditioning, and mirrors.

Electronic windshield wipers that automatically adjust their speed to the amount of precipitation.

"Write on" computers as data entry terminals for nontypists. Each number and letter that one prints appears instantly on the built-in display screen, one line at a time. Material can be edited and errors corrected before it is sent to the main computer.

LEXIS, the electronic legal library, is a computer-assisted legal research system that finds 90 percent of the topics/cases desired in less than 15 seconds.

Salespersons carry a calculator-type device with them and key in orders while in the purchaser's office or store. Data is transmitted to the seller's computer via the telephone at that moment or later in the day.

Car with under-the-hood transmitter that broadcasts an identifying number and diagnostic information as the car approaches a dealership. The dealer's computer could then print a work order, listing the owner's name and address, the repair history of the car, an analysis of the symptoms, and an "alert" on any outstanding recalls.

Pulse reader that contains a microcomputer for nurses and doctors.

A computerized thermometer for taking temperatures.

Electronic tags (much like the present price labels) to stop shoplifting.

Dow Jones News retrieval and stock market activities using a personal computer or terminal.

"Kitchen System," a series of four programs for the Apple II with information on various levels of meal planning, recipes, and ingredients.

Energy management systems (temperature, lighting, and humidity) for buildings of all sizes, including homes.

"TeleTune," a device with an electronic chip; plug in the telephone and a speaker will play back one of eight different tunes for those who are tired of the typical telephone jangle.

A state-run occupational information system using the computer.

Racers wear bar codes (much like the UPC bar codes for groceries) to enable judges to use the computer to record times, names, and winners.

Astrologers give up crystal balls and use the computers. The computer shows the positions of the sun, moon, and planets for every minute in the last 50 years in a program. The astrologer plugs in the client's birth day, time, and place so that the

Computer in a briefcase--take it with you.

"Electronic Handkerchief," a telephone that disguises the voice and that contains a voice scrambler.

Computerized language translator about the size of a handheld calculator.

U.S. Department of Labor, Mine Safety and Health Administration's Enforcement Information System records all the 30,000 or so mine inspection reports made by its 600 inspectors. All data entry is done in the local site, crosschecked, and formatted for cross correlations later.

Electronic "organs" and digital synthesizers that can create the tone and sound of any musical instrument; in fact, they can simulate the whole orchestra! The machine can then play all the instruments at the same time using any programmed speed and time.

Smart thermostats that are digitized.

Speech analysis program (called "Diction") used to analyze Presidents' speeches to determine speech styles; it is programmed to analyze categorical styles as well as individual words or groups of words which the human can then interpret for language style.

Talk to your wheelchair to steer it using a voice recognition device.

"Talking tombstone" which is powered by the sun; it delivers a short message when activated by a special electronic key (the visitor's voice) that allows the deceased to deliver a recorded message to a loved one after death ($10,000).

A "marrying" computer--the couple keys the "I do" responses into the computer during the wedding service.

"POSitalker," a talking cash register; the terminal contains a speech synthesizer that calls out the prices of all items as they are passed along the laser scanner.

Talking watches and clocks that announce the time; most have at least two alarm settings; some play musical melodies as an alarm.

Home Command Center, a computerized monitor that controls lights, thermostat, and appliances.

A "space age" turtle, a microprocessor transmitter is attached to big sea turtles (an endangered species) and permits the turtle to be tracked by satellite.

A computer that prints out braille.

Cordless telephones (often called mobile phones).

Pocket-sized computers.

Wristwatch computers with a disc drive built in.

Encyclopedias that talk as the reader views items on the computer screen.

Computerized mail-order catalogs using a videodisc and two-way cable television (Sears, Roebuck and Company are experimenting in Washington, D.C., and Cincinnati).

Filmless cameras in which the film cassette is first inserted in a television set to view the photographs; if desired, they can be printed out later.

Chips that see (a combination of microscopes and telescopes with semiconductor chips or "imager" chips) make it possible to:

> Raise a submarine's periscope at night and take pictures of a warship four miles away by starlight alone.
>
> Cut logs into lumber after an electronic eye determines the best way to cut the log to get the most lumber.
>
> Smaller, lighter cameras with more power.

Electronic mailmobile without a human driver but programmed to deliver mail at predetermined work stations in a building.

"Touch Now" television shows that permit audience interaction with the program being watched.

Computers used for lobbying and politics.

Burlington Northern Railroad's computerized system to schedule, merge, and maintain freight operations.

STOCKPAK system from Standard and Poor's lets the user manage his/her own stock portfolio; it provides microcomputer access to a Portfolio Management System, Screen and Select System, Report Writing System, and a Demo Data Base involving 900 common stocks.

Kurzweil machine equipped with an OCR scanner and a voice synthesizer for reading the ordinary printed or typewritten page for the blind.

"Speech+" calculator for the blind; it announces numbers and results (Telesensory Systems, Inc.)

"Autocom," a portable communication aid built into a special wheelchair laptray. The verbally handicapped individual touches a square (which can be programmed in size for his/her physical capabilities) that represents a specific word or phrase; 59

different levels of electronic memory with various amounts of vocabulary can be programmed by computer in the laptray (Telesensory Systems, Inc.)

Computerized bathroom scales.

International microcomputer network to help "boat people" find their families and friends.

Transmission of the entire ENCYCLOPAEDIA BRITANNICA in just two seconds.

Stolen automobiles that "beep" for help using a Tracker Mobile Sentry (a hidden transmitter sends a signal to the control center when someone tampers with the car).

Agriculture applications that include

> Least-cost ration feeding programs used by dairymen to design an appropriate diet for their herds.
>
> Herd improvement programs based on genetic records.
>
> Automatic feeding and milk recordings for electronically identifying the most productive cows.
>
> Computer auctions for selling livestock.
>
> Production record averages for individual animals or herds.
>
> Land use planning.
>
> Calculating grain drying costs and efficiency.
>
> AGNET, an IBM program begun at the University of Nebraska in 1975 that includes a number of computerized agricultural programs.
>
> INSTANT UPDATE provides information affecting commodity prices and crop yields as well as access to WASHINGTON WATCH NEWS for farmers (sponsored by Tandy Corporation and Professional Farmers of America); it includes a daily morning newsletter, report on opening prices in the commodity markets, and updates on markets throughout the day, including evening market summaries.

Electronic tire check unit that automatically adjusts to the pressure; it sounds a tone when the keyed-in target is reached.

Freight cars (68,000) tracked over an 11-state Santa Fe Railroad network of 12,000 miles of track in a three-part operation: (1) management and accounting (waybill processing), (2) freight-car routing and in-yard management, and (3) "piggybacking" operations (MIS WEEK, 12/1/81, p. 1).

Retail stores that sell computers.

Computerized collection scheme used by Boston for parking offenders; the computer automatically sends a ticket directly to the offender's home and also maps out parking patterns of chronic violators (making their cars more susceptible to towing).

Resident Credit Reporting Services used by the Houston Apartment Association; it is a computerized program to keep track of high-risk renters. Resident managers send move-in and move-out data such as "broke lease," "skipped," "eviction," and the number of "bad checks." In return, they receive data about new applicants before renting to them.

Keycard to prevent thieves from "hot-wiring" a car. Driver inserts Keycard into a mini-circuit board coded only for the owner.

Realty management and real estate sales software that features mortgage, income, and property-analysis features as well as cash flow needed for purchases.

Computer-based color-coding system that displays all accounts due; for example, accounts due in 30 days are displayed in red; those due in 60 days in green; and so on.

Computerized Japanese dictionary that can process thousands of different characters directly.

Displayphone (Northern Telecom of Ontario, Canada) that combines the capabilities of a telephone and computer. It features hands-free talking, lost-number redialing, sends and receives messages electronically, obtains information from data banks, displays frequently used phone numbers, and dials phone upon a two-digit entry.

A pager (Motorola's OPTRIX) parades and/or stores a message of up to 80 letters, numbers, and spaces across its display. OPTRIX "beeps" but user can also be alerted by vibrations (to avoid disturbing others or for use by deaf people).

A "mouse" (pointer) developed by Xerox for use by a nontypist in running a computer.

"Grocery Mart," a software program that runs on Radio Shack computers. It is a computerized shopping list for homemakers that prints out a complete list of items in the order they appear on the local grocery store shelves, the average item cost index, the approximate total cost of the shopping trip, and coupon reminders.

"Shoplist," a software program that runs on Radio Shack computers. It features computerized recipes for meals and prints out the ingredients for weekly meals; it also prints out a shopping list by grocery store order.

"Dinner's On," a software program that runs on Commodore PET computers. It provides computerized menus for 25 days, prints out a sorted shopping list for the whole menu, lists all ingredients for each meal, and picks a dessert for each day based on the user's 15 favorite desserts.

Computerized diet analysis programs that analyze your diet for nutritional or caloric deficiencies and for calorie excess. These programs also calculate ideal weight based on height, sex, and frame size; then it keeps the records over a given time period (known as "Diet Analysis" for Apple computers, "Weight Control and Nutrition" for Texas Instruments computers, and "Diet Mate Weight Loss Predictor" for Radio Shack computers).

"Grammatik" is a software program promoted as a writing-style analyzer; it locates repeated words, "wordy" sentences, unbalanced parentheses and/or quotation marks, gender-specific words, awkward phrases, certain punctuation errors, and many other types of errors.

Digital watches with time, alarms, stopwatch, hourly time signals, calendar, days of the week, music, and calculator functions.

Watches that combine time functions and an electronic game.

Electronic computer-controlled drill press for the home workshop.

Computerized genealogy program called ROOTS89 from Heath Company.

Computer-simulated flight tests to teach military pilots to fly, refuel in mid-air, drop missiles, navigate, take off and land; the simulations include 64 varying colors with moving targets, clouds, landscapes, and sound.

Computerized services to help students locate scholarships.

Microprocessor-controlled automatic "bartenders" that are installed in over 300 drinking establisments over the country by American Beverage Control Corporation; they mix more than 1,200 different drinks, control the inventory, and keep the books.

On-line computerized food stamp program used by the Michigan Department of Social Services to validate eligibility, automatically generate an "authorization to participate" card, and post each client's transaction to the computer. The system eliminates the possibility of the client obtaining authorization at another food stamp center and receiving duplicate allotments.

Software that computes Flesch's readability formula while checking spelling (from Legist Automation, Arlington, Texas).

Beef breeding registry service (American Angus Association) that stores registrations of 10 million cattle, issues pedigrees, evaluates performance of cattle, and operates a herd improvement records program.

A computer for losing weight (Cal-Count) with a motion sensor that calculates body movements and converts that into calories that are worked off during exercising activities.

Design of typefaces by computer using a "metafont" system.

Computerized metered mail machines.

Computerized office layout programs.

"Talking Calculator" eliminates two-person "proofing" of entries.

Computerized office appointment calendar program to make it easier for planners to schedule meetings at convenient times.

Voice-operated telephone dialer in testing stage by Bell Labs.

Computerized musical instrument lets user pick any one of five instruments, record 100 notes and play them back, select pitch and tempo, and select preprogrammed rhythms. The instrument can serve as a calculator also.

Shopping via cable television and a computer through Comp-U-Card of America; customers phone a toll-free "800" number.

Freezer and refrigerator inventories on the computer help the homemaker avoid opening the freezer door and wasting electricity; the software program is designed to inventory the meat (or other products) by age, weight, and amount.

Cars with computers that answer 20 different inquiries; retrieve data such as estimated time of arrival, distance to empty fuel tank, and instantaneous mileage readout; and control a keyless entry system to lock/unlock door electronically.

"Hi-Ovis" (experimental two-way Optical TV Communication System in Osaka, Japan) subscribers have an ordinary television set and television camera, microphone, and remote-control device for voting so that they can watch television, participate in two-way meetings, attend class, ask and answer questions, give opinions, and even vote--all from their own living rooms.

Electronic engine management system controlled by a microprocessor to automatically regulate carburation, spark timing, and recirculate exhaust gasses through the engine.

Computerized ticketing for sports and entertainment events available on the home phone via cable television systems.

Football coaches (and others) use the computer in game analyses such as key information on plays, player tendencies, downs, and distances; it even provides player profiles.

Microprocessor-based patient monitoring system for intensive care units in hospitals; as many as eight vital signs can be traced and recorded for a 24-hour period on this "Medivision"; they can all be graphically displayed simultaneously and even be "frozen" in place and/or printed out. Alarms are built in, also.

These and many other practical uses (or gadgets) are described in news items and/or are advertised in journals and newspapers. In most cases the electronics component only replaces some other form of "power"; consequently, the numbers of truly "innovative" applications that make use of the uniqueness of electronics/computers are rare.

INTERNATIONAL CONCERNS

The four big producers of computers are the United States with $30.5 billion in sales, Japan with $8.6 billion, France with $8.3 billion, and Germany with $8.3 billion. The United States produces three times as many computers as any one of the other three world leaders and as many as all three countries together (U.S. Department of Commerce, 1980).

Technological progress is not necessarily tied to dominance, according to some experts. Therefore, great concern has been expressed in the United States about workers' productivity, technological advances, and decreased emphasis and financial support for research and development.

As a result, three major international concerns about computers emerge: (1) technological espionage, (2) international marketing concerns, and (3) transborder data flow.

TECHNOLOGICAL ESPIONAGE

Fears about technological espionage occur most often between the four major computer countries and those that do not have computer development capabilities. Each country's desire to market computers increases the possibility of exporting the development and manufacturing capability, also.

INTERNATIONAL MARKETING

The United States computer industry is concerned about international marketing, especially Japanese imports to this country without corresponding access to Japanese markets. The Japanese have been successful in capturing a sizable proportion of the United States market for automobiles, steel, shipbuilding, and televisions; many fear that they may attempt the same success in computers by selling semiconductors with more capacity in large quanitities, in manufacturing and selling miniature computers with multiple functions, and through selling equipment (computer in nature) at a lower cost than the American-made products.

The United States is vitally interested in maintaining and opening up international markets in both highly developed and Third World nations.

TRANSBORDER DATA FLOW

Transborder data flow is a term used to describe the transfer of data or information from one country to another through various media--television, satellite communications, files, radios, and newsprint. There are three major types of policies to consider: (a) economics and informatics policies, (b) data protection policies, and (c) telecommunications policies (BUSINESS WEEK, 8/3/81, p. 10).

Transborder data flow may cause ever-increasing economic dependency when data flows from a nation with telecommunications capabilities to one without such capabilities. The information-dependent nation becomes heavily reliant on the information-rich nation for technical information, media (entertainment as well as news) products, and data processing functions. Such an imbalance causes the information-dependent nation to become more dependent and reduces its national sovereignty.

Policies about data protection center around the basic rights of individuals in relation to computerized record systems that are capable of instantaneous access on a worldwide network. These concerns include proliferation of personal data in many databanks, vulnerability of these systems, misuse, accuracy or inaccuracy in the data, completeness of the data, control of data, and transmittal controls. The Council of Europe and the Organization for Economic Cooperation and Development (OECD) are developing guidelines in these areas.

Telecommunications policies involve governmental agencies and global networks. Technological considerations are involved in satellite transmissions, hardware, software, and fiber optics. They involve decisions about standards and capatibility of one system with the other. The decision to select one standard or protocol over another, after nations and businesses have spent billions of dollars in money and effort, has a great effect on who controls the marketplace and who has access to it.

Another concern involves a nation's control over revenues for telecommunications broadcasts to its citizenry and concerns about which programs are selected. For example, a government in an underdeveloped country may not want U.S. television programs that they depict an affluent society and stress individualism to be shown to its citizens. At the same time the United States may desire to influence the possibility of freedom around the world; broadcasters will want to make a profit while doing it.

The policy about permitting free versus restricted transborder data flow has a great economic importance to all nations and to many companies with international markets. Domestic issues are no longer totally different than international issues.

Some experts predict that World War III will be fought with computers. Such a war might occur through direct sabotaging of a computer and its programs or possibly through filling the computer with highly inaccurate data and causing economic chaos!

SUMMARY

The societal effects of communications technhology are very pervasive; they evolve slowly in some ways and rapidly in others. However, technology advanced in communications, especially through computers and telecommunications, permeat the daily life of the average citizen personally and workwise.

The Year 2000 may be an entirely different society "externally" through electronic forms but the inherent "humanism" of the individual will be unaffected.

CHAPTER IV

EDUCATION AND CAREERS

Almost every individual and every job is affected by computers. In some cases, there is a direct contact between the worker and the computer; in others, the contact is indirect and involves computerized activities (such as payroll preparation or inventory control in an assembly plant) that do not require direct contact. Societal and governmental needs for information are often met through the use of the computer.

Consequently, the last years of this century are directly tied to the use of the computer; careers are changing and will continue to change. General education and career education, both career guidance and vocational training, must integrate the computer as both an instructional tool and as a piece of work equipment.

COMPUTERS IN EDUCATION

Computers in education are rapidly bcoming a necessity. Although computers have existed for a number of years, and CAI (Computer-Assisted Instruction) and CMI (Computer-Managed Instruction) were introduced several years ago, the integration of computers in the educational mainstream did not take place as soon as predicted. Computers were expensive; they were difficult to program and "unfriendly" to use. Furthermore, special training in data processing or computer science was required, and few educators had such training.

Nevertheless, computers have changed and are now used extensively in the business and industrial world. Costs have dropped, the amount of trained required to use a computer has dropped, and user-friendly programs are being developed.

The microcomputer generation brings the computer out of the backroom and out from under the control of data processing specialists to some extent; they are operable by generalists with a minimum amount of training. At the same time there is still a gap between those who "know" and are trained and those expected to "use" and teach computer applications.

In fact, the term "computer literacy" (in contrast to "computer illiteracy") is now used to describe the minimum level of understanding needed by educators, workers, and students. Everyone should know what computers are, what they are used for, how they operate in general, and how to write simple programs; everyone needs to know how computers affect society and the individual.

Schools from elementary to university levels are awakening to the need to use computers in educational programs from basic language development to basic math development, from science education to vocational education, and from statistical analyses for research projects to classroom and administrative management.

PURPOSES

The computer (whether it is a microcomputer or a terminal attached to a mainframe computer) may be used for four educational purposes:

Instruction (CAI)
Classroom management (CMI)
Administrative management
Education for the handicapped

TYPES OF APPLICATIONS

Generally speaking, the computer is used for six different types of instructional applications in the school setting:

(1) Drill and practice routines
(2) Simulation and gaming
(3) Tutorial instruction
(4) Information retrieval
(5) Problem solving and decision making
(6) Vocational training (as provided for typewriters and lathes)

The principles of learning should be followed by anyone developing educational programs for the computer. For example, the majority of "typing tutorial" software programs on the market by 1981 violated all known research on developing typewriting ("keyboarding") skills. Notably, they were based on learning nonsense syllables, introducing comparable keys with opposite hands ("i" and "e") in the same lesson, and other ineffective practices. By 1982 publishers with expertise in keyboarding skill development had developed software programs based on research data.

Computer-aided instruction programs should be innovative and use the unique features of the computer--namely, the high speed available for branching through programmed instruction, complex simulations involving little to massive amounts of data and many variables, logic and sequence activities, interactive capabilities, and combinations of motion and graphics with text.

Research has been underway for many years in the area of artificial intelligence; that is, attempts to simulate human thinking in areas where judgment and logic must be applied. Such computers (and such programs) require huge memories with volumes of varied information as well as programming that identifies and evaluates all known alternatives. Only limited success at low levels of intelligence have been achieved so far; the human brain is still an unfathomable resource. The educational process must continue to work towards further development of the individual's ability to reason and make judgments and thus reach more of the brain's potential.

About 6 percent of the elementary and secondary schools had some computer instruction by 1980, but that number is expected to rise to 9 percent by 1983. After that, the percentage is expected to rise sharply.

PROBLEMS

The acceptance of computers in education is occurring very slowly in many schools; only a few of the current teachers and administrators seem to be interested in using the computer as an integral part of the educational process. Some of the problems in promoting such integration are:

Lack of funds to buy hardware

Lack of adequate quality software

Difficulties with service on equipment

Lack of teacher training

Lack of compatibility between different brands of microcomputers

Lack of criteria for evaluating hardware, software, and students' learning

SPECIAL PROGRAMS

The problems of integrating computers in the educational setting are being met in various ways by educational institutions across the nation; they include special programs and new curricula. Some states have launched massive statewide programs whose sole aim is to integrate the computer into the educational process at all levels.

Initially, "Computer Awareness Days" are sponsored by institutions or professional groups, by consultants providing in-house training programs, and by manufacturers of equipment or producers of software.

"The Computer Gallery" is a game park of educational (and gaming) programs sponsored by Anheuser-Busch Entertainment Corporation in connection with Sesame Place.

Educational sessions for children are sponsored regularly by companies such as Control Data Corporation and Xerox Corporation as a means of testing software and hardware.

The Lawrence Hall of Science, an affiliate of the University of California in Berkley, is a complete science museum with exhibits and study programs. They include microcomputers with educational software, including games. "Hands on" experience and learning sessions are sponsored for both teachers and students.

Some computer camps are sponsored in the summer for children of all ages (California, Texas, Connecticut, Chicago, and other locales).

"ComputerTown, USA" is a community-based project situated in the public library at Menlo, California. Microcomputers are available in a special room; volunteers aid children and adults in "hands on" experience with both educational programs and games.

The University of South Alabama initiated a unique application integrating telecommunications with education. It installed satellite communications to provide foreign language students with "live" television broadcasts from countries representing the languages they are studying.

The Minnesota Educational Computer Consortium is an example of a state-wide project in which planned activities support the use of microcomputers in the classroom. The project funded the installation of a microcomputer in each elementary and secondary school in the state and continues to provide workshops and inservice training for instructors. Software programs are developed and then shared with others in the consortium; they are available for purchase by other schools also.

CAREERS AND THE COMPUTER

The prevalence of computers in business and industry has changed and will continue to change career patterns; in fact, computers affect the tasks and duties performed by workers on many jobs. Thus, the computer may be viewed as a "career changer" on one hand and a "task changer" on the other hand. Both of these factors affect workers and the way they are trained for work.

TYPES OF WORKERS AFFECTED

There are four types of workers affected by the integration of the computer in the workplace: (a) data processing specialists, (b) managers and professional people, (c) computer users other than managerial personnel, and (d) workers who are replaced by the computer.

JOBS AND COMPUTER SKILLS

Examples of job titles (found in newspaper advertisements) that require computer "skills" and understanding include:

> IRM (Information Resources Manager which includes the planning, budgeting, organizing, directing, training, promoting, controlling, and other managerial activities involved with the creation, collection, use, and dissemination of information; includes data processing and telecommunications, office administration, statistics, libraries, records and paperwork management)
>
> Performance Measurement Specialist (using the computer)
>
> Information Manager
>
> Job Security Worker (for the computer facility)
>
> Automated Office Worker
>
> MIS (Management Information System) Director

Customer Services Representative (involves ability to retrieve data and handle mistakes from the computer for customers, particularly in banking, credit bureaus, and utility companies)

Programming Maintenance Workers

Data Entry Workers (to input data at terminals)

Sales Representative for Computer Graphic Terminals

Director of Marketing Communications

Telecommunications Planner

Electronic Communications Manager

Many of the jobs listed above require electronic engineering degrees; others require data processing or computer science training. Some do not require any training at all; the employer provides it, espcially for those jobs that are routine such as the data entry worker.

EFFECT OF COMPUTERIZED AUTOMATION ON JOBS

While growing numbers of workers will need some understanding of computers and some will need to learn to operate a microcomputer, computer terminal, POS terminal, word processor, and/or some other computerized machines, other workers may find a computer replacing them. Automation may significantly reduce the number of jobs in the following areas (BUSINESS WEEK, 8/3/81, p. 67):

In factories:	No. of Employees Lost
Assemblers	1,289,000
Checkers, examiners, inspectors, testers	746,000
Production painters	185,000
Welders and flame cutters	713,000
Packagers	626,000
Machine operatives	2,385,000
Other skilled workers	1,043,000
In offices:	
Managers	9,000,000
Other professionals	14,000,000
Secretaries and support workers	5,000,000
Clerks	10,000,000

Concerns about the reduction of workers in the labor force are expressed by specific segments such as banking, printing, telephone, and textile industries. In addition, many assembly plants (manufacturing) may install robots to perform routine work, thus reducing the number of assemblers needed.

For example, automation in the textile industries reduced the number of workers in one spinning mill from 435 to 95 without reducing the quantity and quality of work. Garment manufacturers are turning to computerized systems for laying out patterns on materials and to computer-controlled laser cutting in efforts to reduce costs without hurting productivity.

Banks require 30 percent fewer workers when they automate with computers and on-line terminals. Printing plants require fewer workers because the words are typed only once; they are then manipulated by workers at terminals and sent directly to the printing presses, thus eliminating several layers of workers and requiring new skills of those workers remaining.

The 1980s telephone is an electronic switching device; therefore, knowledge of computer-based systems and programming are required. Mechanical repair skills are being eliminated. Transmission systems craftworkers will need fewer skills as most fiber optics and microwave systems are the "plug in" type.

The number of telephone operators has been steadily declining because of the installation of direct distance dialing and the use of electronic consoles to intercept calls to disconnected or nonworking numbers (which even give the changed number in a computer-assembled voice response). Prewiring of buildings during construction, "do-it-yourself" phone installation, and charges for directory assistance have further decreased the need for employees.

New ways of using the telephone's communications network, such as electronic funds transfers, electronic mail, and home data processing, are not expected to affect the number and/or type of employees needed by the telephone company to any extent.

However, when electronic mail becomes a viable option to the postal system, the number of U.S. postal employees needed will drop sharply.

All in all, some experts predict that approximately one fourth of all the jobs in industry are likely to disappear by the Year 2000. The need for service workers, however, appears to be increasing.

The latest DICTIONARY OF OCCUPATIONAL TITLES (Fourth Edition, U.S. Department of Labor, 1977) illustrates some of the ways that jobs/job titles are changing. It contains descriptions of job duties for 20,000 occupations; 3,500 obsolete job titles were deleted and 2,000 others added in the latest edition. Some job titles added were "supervisor, word processing," "in-file operator (who operates CRT)," "terminal-system operator," "data typist," "data-coder operator," "photocomposition-computer operator (using video display)," and "MTST (Magnetic Tape Selectric Typewriter) operator." The last one, the MTST operator job title, is rapidly becoming obsolete as visual display word processors continue to advance in the marketplace.

Computer employees are sought at all levels, with the demand rate averaging over 20 percent per year. According to a Fox-Morris/MPC Mid-1981 survey, "applications programmers" with 3 1/2 years' experience will experience a 27 percent rise in demand; "systems/software programmers" with 4 years' experience, 24.4 percent rise; "systems analyst" with 5 1/2 years' experience, 21 percent rise; "telecommunications specialists" with 2 1/2 years' experience, 20.7 percent rise; "DP auditors" with 3 years' experience, 19.8 percent rise; "systems managers" with 6.7 years' experience, 19.2 percent rise; "data base managers" with 8.9 years' experience, 18.3 percent rise; "software engineers" with 4.7 years' experience, 17.3 percent rise, "MIS (Management Information System) directors" with 14.3 years' experience, 11.7 percent increase; and "B.S. computer science graduates (entry level), 10.1 percent rise (COMPUTERWORLD, 7/20/81, p. 6).

The total number of programmers rose from 10,000 in 1955 to 80,000 in 1965 and to 220,000 in 1980; the programmer population is expected to grow to over 300,000 by 1985. Their producitivity level grew by only 3 percent per year, however. Furthermore, the number of computers increased also, going from one general purpose and no dedicated computers (those used for process control and manufacturing operations) in 1955, to 20 general purpose and 2.5 dedicated computers by 1965, and to 150 general purpose and 220 dedicated ones by 1975. Predictions indicate that there will be 925 general purpose and 330 dedicated computers in existence by 1985 (G. T. Orwick, "The Plight of Programming," COMPUTERWORLD, 1/15/82, p. 110). The number of programmers per computer dropped from 10 in 1955 to 3.6 in 1965, and to .98 in 1975; they are expected to drop to a ratio of .3 programmers per computer by 1985 (MODERN OFFICE PROCEDURES, 12/1981, p. 54).

Obviously, the need for trained computer personnel is increasing; more people must be trained at all levels. Furthermore, new ways to increase the productivity of such personnel must be developed. No one knows what effect the microcomputer will have on the need for trained computer personnel.

Two career paths have evolved and thus two different curricula are used in training computer specialists: (a) *computer science* curricula which is heavily oriented to hardware/software technical knowledge, systems analysis, programming and languages, and heavy emphasis on math; and (b) *CIS* (Computer Information Science) curricula which is geared to management/decision-making situations (especially for the business world) using information analyzed by the computer.

As noted above, *managers* are needed in setting up and then supervising business information systems; whether these workers need a computer science or computer information science background is an unanswered question.

However, all managers need to be conversant with the computer and its abilities and capabilities. As more and more electronic workstations are integrated in managers' offices, more and more training must be obtained by managers for two purposes: (a) knowing what information is needed and in what form it is needed, and (b) knowing how to obtain the data from the computer using the computer.

SUMMARY

Education and careers are affected by the computer, both in negative and positive ways. There is no question about whether the computer will be used or not--it is here and it will stay. In fact, we could not exist in today's world without it. We do need to utilize the computer's power and capabilities in the best ways for our human resources. In other words, the computer is a tool, and people use tools for their own benefit.

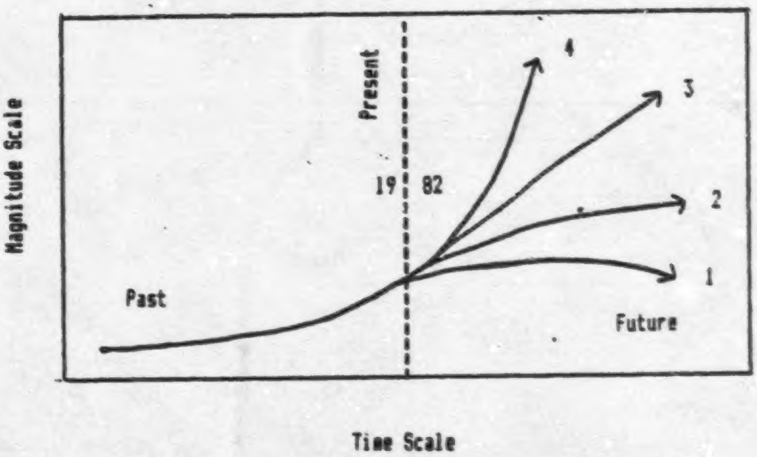
CHAPTER V

PREDICTIONS AND IMPLICATIONS

Predictions and forecasts involve the placing of events on a time scale and a magnitude scale (Figure 12) after assessing the most optimistic and the most pessimistic options. Forecasts tend to be more specific about the time at which events are likely to occur while predictions generally indicate that the event will occur but does not give a specific time frame. Both are equally difficult to make in terms of the magnitude of events and/or trends. Exact time tables for predictions are not included because of the volatility of the communications technology areas.

FIGURE 12

TREND LINE OPTIONS IN FORECASTING



THE PREDICTIVE FRAMEWORK

Four types of communications technology were identified for study at the outset of this project: computers and data processing, telephones and telecommunications, word processing, and reprographics.

Each technology was judged by one of four levels of magnitude: (a) technologies in widespread use now or by the Year 1985; (b) technologies in existence and products available but not in widespread use; (c) technologies in existence but not available for use yet; only prototype or experimental examples are on the drawing boards or in laboratory settings; and (d) technological "dreams" and/or advanced basic scientific products perceived but no practical usage or foreseeable use projected as yet.

Finally, the predictions were judged in terms of four time-linear stages; namely, categories such as 1980-1985, 1986-1990, 1991-1999, and 2000 and beyond. It is important to note that the time frames are not equal, due to the increasing difficulty of predicting events at greater distances from today.

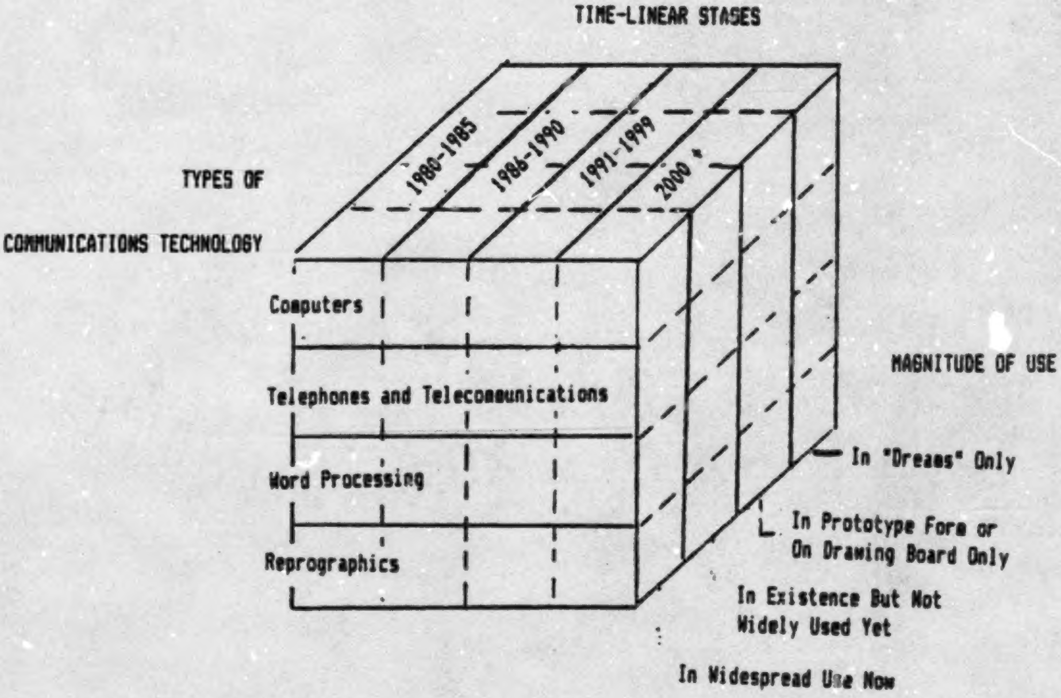
Therefore, a three-dimensional matrix (Figure 13) developed when the four levels of time, four types of communications technology, and the four levels of magnitude were combined. The complexity of the topic was multiplied as each new dimension was added until the configuration resembled a Rubik cube; each cubed cell may be "looked at" and "rotated" separately. However, the computer runs through all cells and unifies them into one technology, albeit a very complex one.

Innovation is responsible for fully 45 percent of all productivity gains in the United States in recent decades, according to Brookings Institute; a third of that is directly traceable to the computer (FORTUNE, 4/81, p. 42).

However, the powers of the computer and the other technologies have not been fully utilized. Computer power has generally been introduced into work and/or thinking that has existed for years; in effect, the computer has made it easier to do the same things that have always been done. The computer is simply replacing manual work; there are few instances where it has been used in creative ways beyond today's activities. The computer calculates faster than a human being, follows step-by-step procedures endlessly, and makes routine decisions without supervision by simply following a well-designed program.

FIGURE 13

A THREE-DIMENSIONAL VIEW OF FACTORS RELATED TO PREDICTIONS



Communications technology has already affected the workplace and the home, and it will be an ever-increasing consideration for vocational educators in providing initial training and retraining in the next few years. Therefore, the following predictions are made; implications for education in general and for vocational education are then drawn from the predictions.

PREDICTIONS

The predictions in this section relate to trends with only occasional references to the optimal time. The predictions related here are based on the facts and data cited earlier, on experts' opinions in the various technological areas, on predictions made by futurists, and on intuitive interpretations.

PREDICTIONS ABOUT COMPUTERS

COMPUTERS will increase in number and in power while decreasing in cost until about 1990. They will increase in functions, capabilities, and speed; they will increase in friendliness to the user (especially the nontrained user).

By the Year 2000

> approximately 75 percent or more of the homes will have an interactive, two-way computer/television system that will include fire and burglar alarm systems and environmental control systems (temperature, humidity, and other controls).
>
> 90 to 95 percent of the professional and managerial workforce will carry a personal computer (a combination computer and word processing machine).
>
> 90 percent of the adult citizens in the United States will carry at least one microprocessor with them wherever they go--and it will most likely be embedded in a plastic card used for electronic money and banking purposes (and perhaps one that serves as a driver's license and Social Security card).

Wristwatch-sized computers may exist but they will not be practical because of the difficulties of entering data and of reading output.

TYPEWRITERS will change--electronic and electric ones will not be manufactured in the very near future, possibly as early as 1985.

TECHNOLOGIES WILL BLUR until there is no difference between microcomputers, word processors, calculators, and even copier and printers. There will be one multifunction machine which will have a new name; it may be called a "computyper."

COMPETITION between computer manufacturers will continue to flourish through the Year 2000; however, few of the companies manufacturing microcomputers today will be operating under the same names as today.

As the public and businesses become more knowledgable about computers and acquire more purchasing power in the marketplace, manufacturers will be forced to STANDARDIZE hardware, make computers compatible with one another, eliminate the necessity for some types of special interfaces, and develop protocols.

The COMPATIBILITY of computers and peripheral equipment manufactured by various companies will slowly increase.

GOVERNMENT REGULATIONS WILL INCREASE as companies attempt to control all or major portions of computer-related functions; namely, data enhancement during telecommunications, electronics funds transfers involving consumers, nationwide data bases involving private citizens, information "hogging" or control of information, and other "societal" functions.

INTERNATIONAL STANDARDS AND PROTOCOLS for computer systems and telecommunication networks will be in place by the Year 2000.

TRANSBORDER DATA FLOW will receive increasing attention and may inhibit competition, free flow of data and information, and marketing, thus causing further economic and information imbalance between those nation who have and who do not have access to information systems.

The AMOUNT OF INFORMATION GENERATED will continue to grow, and the demand for information when needed and in understandable form will continue to increase. "Information glut" is a reality. How will the human being ingest the vast amounts of information that is available? Will the computer be programmed to "simplify" information into simplistic terms that are often misleading? A "consensus of opinion" is a popularity contest in many ways while one well-conceived experiment may totally outweigh the results of the consensus survey.

The "COMPUTYPER" may not be accepted in the executive suites until around the Year 2000 because the middle-aged manager of the 1980s still believes that "keyboarding" (typing) is a clerical task peformed by subordinates. Younger executives will not have this same attitude.

SECRETARIES, CLERKS, AND TYPISTS WILL DECREASE IN NUMBERS; however, many of these jobs will be integrated into "new" job titles reflecting new job tasks performed on the computer terminal or computyper.

The "COMPUTER ILLITERATE" ADULT CITIZENS of today and in the future will become disfunctional in their financial affairs, careers, and activities related to information. These individuals lack knowledge about the current use of computers, have a fear about learning such a "complicated" subject, have been "brainwashed" about the difficulty level of learning to use the computer in common applications affecting personal lives, and believe that the computer itself makes mistakes when the error is usually caused by the person using the computer.

PREDICTIONS ABOUT COMPUTER-RELATED FUNCTIONS

The use of "DEBIT" CARDS with embedded microprocessors (the miniature branch bank--one to a customer) will grow at a fast rate.

A PASSPORT IN THE FORM OF A "MEMORY" CARD will be issued by the United States and other highly developed nations by the Year 2000.

MANUFACTURING DESIGNERS will routinely use computers and computer graphics to design parts and then to generate tapes for running electronically controlled machine tools and robots.

Computers will TIE THE ENTIRE MANUFACTURING PROCESS together from designing the product to manufacturing it, to inventory control, and through distribution and marketing. There will be drastic drops in inventory-in-progress, quicker machine setup times, and more commonality of parts; there will be a corresponding increase in productivity.

Health care industries will use computers in PATIENT MONITORING and DRUG DOSAGE CALCULATIONS in greater numbers as the nursing labor force continues to dwindle in numbers.

Doctors will turn more and more to COMPUTERIZED DIAGNOSIS assistance.

PUBLISHERS will push deadline hours closer to print times by computerizing everything from original typing to editing, revision, layout and pasteup because of AUTOMATED PHOTOTYPESETTING (even want ads are typed directly on computer terminals during phone calls now).

A totally electronic press--viewing news only on cable television--will not move as rapidly as some predict. Combinations of both paper and electronic news media will still exist in the Year 2000.

"DEMAND PRINTING" will become a reality. Publishers and bookstores will not need to carry an inventory. Rather, the customer will view the book using a computer terminal; if he/she wants to purchase it, the "book" is telecommunicated to the store and printed there. Or the customer may buy the "BOOK" IN ELECTRONIC FORM--on disc to use in a computer.

ENERGY MANAGEMENT of buildings and homes will continue to grow in importance and functions. The necessary computerized equipment will be installed in new buildings during construction.

OFFICES will become increasingly MORE AUTOMATED with networks that can handle voice, video, and data traffic--but the information glut will continue to grow. These networks will tie together word processing, data processing, telecommunications, and copying processes.

Although the population of information appliances is growing ten times faster than the workforce as a whole, the POOL OF COMPUTER SPECIALISTS is growing at only one fourth the rate of installed computers. By the 1990s many people will be able to operate "user-friendly" software programs but less than 10 percent of the population will be capable of or interested in writing their own programs. However, individuals will have more opportunity to review software programs before buying them to determine if they are indeed suitable.

BANKING will change drastically before 1990 as the EFT system grows. Consumers will be forced to accept electronic banking in handling their finances. Banks, however, will not be housed in huge, monolithic buildings because consumers will use interactive, two-way telephone and cable television sets to conduct their business. If the customer does not have a facility at home, the 24-hour bank teller machine may be used.

AUTOMATED TELLER MACHINES for banks will stay open around the clock; competing banks may even use the same facility in locations where there is little traffic. Each bank will issue its own 24-hour identification card as usual.

Grocery stores, restaurants, and other types of businesses will join the retail and wholesale stores in using ELECTRONIC POS TERMINALS in permitting customers to use "debit" cards before the Year 2000, thereby contributing to the "paperless society."

Electric and gas UTILITIES will turn to long-term forecasting of weather in planning new facilities.

FEWER METER READERS will be needed by utility companies as their meters are connected to the cable television systems installed in homes.

FARMERS will use computers in greater numbers to determine feed mixtures, irrigation amounts and times, crop rotations, and herd improvements. They will maintain more historical data on each animal in the herd, for example, and keep only those that are truly productive.

Both the federal and state governments will use more CROSS-CHECKING OF MASTER FILES to eliminate fraud, especially in welfare and income tax programs.

ELECTRONIC SHOPPING will be commonplace for the majority of the people by the Year 2000; it will not totally replace the shopping mall for many individuals will want to examine the merchandise in person; others view the mall as a socialization center to some degree.

TELECONFERENCING will be highly advertised but will be successful only for highly structured situations, such as in-house business meetings, educational or training purposes, and small professional groups. Conventions will continue to flourish although major presentations will be telecommunicated.

ERGONOMICS, the designing of furniture and equipment for computer users and computypists, must receive more attention. By 1990 this emphasis will taper off.

HUMAN FACTORS AND HUMAN VALUES must be considered in assigning work and in evaluating rewards for different types of work; this area will continue to grow through the Year 2000.

ARTISTS will develop more sophisticated computer imaging technology for more of the arts. Computers will aid in detecting forgeries in all types of art.

ANIMATED FILMS will increase in number and complexity as computer techniques are used for most of the repetitive drawings.

PREDICTIONS ABOUT EDUCATION AND SOCIETAL EFFECTS

The EDUCATION SYSTEM in the United States has failed for the most part to perceive its role in the Micronics Age; it cannot continue to blame its participation on lack of finances. Cost is not the reason--the lack of teacher training is the major block today.

VOCATIONAL EDUCATORS will either acquire computer skills, or the entire system may be bypassed for business and industrial training.

There is, however, a GROWING COMPUTER LITERACY as more schools begin computer training, as parents buy television games and handheld calculators in greater numbers, as more consumer advertising stresses computer power, and as more home and personal computers are purchased by the general public.

SOCIAL PROBLEMS WILL INCREASE rapidly between now and the Year 2000, particularly in the areas of invasion of privacy, freedom of information, consumerism and advertising techniques via electronic means, equity in obtaining public information through personal computers, and socialization that commonly takes place in schools and the workplace.

The concept of "WORKING AT HOME" will affect some workers but will not be available to the majority of workers and then only for workers under special conditions--handicapped workers, specialized fields where trained workers are scarce, workers who generally perform the type of work done in isolation (word processing of dictated materials, executives who work outside of regular hours or while traveling).

SOCIAL SYSTEMS involving electronic funds transfers, electronic voting, electronic poll-taking or recordkeeping, and interactive programs depend on the majority of homes having the interactive, computerized network systems and the majority of the individuals being comfortable in using it for all such activities. Many people will choose to use such functions; others may not have the equipment. Therefore, electronic voting may not be possible for many, many years. The other options are tied to the financial ability to purchase equipment and an interest in using it when it is available.

Publishers must produce educational materials to use with compuers, or electronic manufacturers will produce their own. These materials should be prepared for every education level--elementary, secondary, collegiate, adult, and in-house company training.

Publishers should use computer technology in producing books to maintain currency of content and to reduce costs.

New methods of selling computer software must be developed to replace free examination copies of books usually sent to educators.

Colleges will offer and deliver courses to the home via computer/television.

Students may access many data bases for almost immediate display of data or graphics on their television screen--as soon as all the material is electronically recorded and if the student is skillful in searching data bases.

The economics of maintaining a 20-to-1 student-faculty ratio in the Year 2000 will be expensive because it is labor-intensive; also, the cost of maintaining the physical plant will be high and the cost of commuting/bussing will remain high.

NEGATIVE PREDICTIONS

Economic conditions, user acceptance, necessity for training, and a demonstrated need for technology and its products shape the likelihood of an event occurring or a trend rising or falling. Some major blocks to achievement of many of the previously stated predictions exist; a few are identified here:

Mismatches in interfacing an individual with a machine(s)

Lack of software support needed to use computers effectively

Reliability problems

Regulations that impede growth and usage

Decision-support systems that are too elementary at present to make full use of computers as management tools

The attitude that the computer is a "god" rather than a "tool"

The danger of an inundation of information and worthless facts that gives the inquirer more data than he/she wants to know; some individuals will be "turned off" and confused by too much information, especially if it is presented in a disorganized or unfamiliar manner

Less physical labor will be needed if the computer controls many functions; those individuals without sufficient intellectual abilities for other occupations may be without work altogether

Some dire predictions were made. While they are unlikely to occur, there is enough validity to mention several here:

High unemployment (as high as 50 percent)

Takeover of all routine functions by robots

Takeover of some low-level intellectual capabilities by robots

Genetics gone wrong with major changes in humans resulting

Death of the post office (average age of employees is over 50 now)

Demise of the school system

POSITIVE ATTITUDE AND CREATIVITY

Ingenuity, creativity, and positive thinking will lead the fight against the negative predictions just cited. However, there may very well be some truth in those predictions; steps must be taken to counteract the emotional and economic deprivations of individuals or segments of society if such changes take place.

THE MICRONICS AGE AND VOCATIONAL EDUCATION

The "Micronics Age" prevails in government, industry, business, and science today, and the use of miniaturized computers and microprocessors is expected to expand in uniquely new applications at rapid rates through the 1990s and into the Year 2000.

VOCATIONAL NEEDS

Vocational educators--leaders, administrators, teacher educators, and teachers--face a twofold challenge: (1) acquiring computer skills themselves and (2) training prospective (and experienced) workers to use computers and computerized equipment on the job. The problem is complex because of the rapidity of change and the ever-increasing number of applications in every vocational field. Developing and maintaining a futuristic viewpoint is difficult when computer technology changes every two or three years and when uniquely new capabilities and software constantly emerge.

THE NEED IS URGENT, HOWEVER.

The computer offers creative ways to increase productivity, both in information processing and in ways other work is performed. The power and ease of use ("friendliness") make computers easier to learn to use than ever before. Software has been developed for many types of applications--and the average person is able to operate computers, especially microcomputers or terminals, with a minimum of training.

All workers--prospective or experienced ones--must understand and operate computers as tools in the same way typewriters are used in office work, as hammers are used in construction, and as rulers are used in drafting. Some workers will develop new computers and service existing ones; some will use the computer's graphics capabilities to design new tools, cars, and buildings. Other workers will use computers to control production lines and program lathes, manage inventories, transfer funds electronically, process shipping orders and payrolls, analyze market forecasts, do markups in the retail store, and make management decisions.

Computers, especially microcomputers, are changing work operations, work patterns, and decision making. All large and most medium-sized companies have used computers for years; small companies of all types--and even departments within the larger firms--are now buying and using microcomputers.

Vocational educators must use these same computer techniques in training workers.

Vocational educators must use the "electronic learning" networks to provide up-to-date curricula and to make such instruction accessible to in-school students, adults at home, workers in the workplace, and others.

Learning at home--or at the workplace--may be possible with satellite and the future "wired home" systems. Children may do homework, drill and practice exercises, problem solving, and instructional simulations on the home computer. Encyclopedias would be accessible via the computer in the home, and they may include sounds as well as pictures and words. Adults may call up home repair information and lessons on hobbies on the computer.

Vocational teachers may take in-service graduate courses while at home; data for research papers would be accessible to all via the library databases. Teachers may teach from the home, and they may take initial training or updated training from the home.

IMPLICATIONS FOR VOCATIONAL EDUCATION

Changes in careers and work patterns resulting from the computer and communications technologies have had and will continue to have a profound effect on vocational education:

> Vocational teachers and administrators must acquire computer skills--that is, they must be knowledgable about computers and be able to use them skillfully in job situations and in teaching.

All careers will involve computer usage and therefore curricula in all vocational programs must incorporate the computer as a job tool and an instructional aid.

The acquisition of computers and/or computer-powered equipment is imperative.

Each vocational program must be carefully examined to determine curricular changes resulting from the increasing emphasis on and use of computers. A few examples of changes for each vocational program are:

Simulations relating to crop-rotation analysis, herd improvement records, budget projects, and farm accounting using the computer may be incorporated in agricultural programs. The AGNET system is an example of efforts to bring farm news and product analyses computer programs to the local farm and school. Instruction using feed-cost computer programs will enhance learning, for example.

Business education programs should require accounting students to use the computer to prepare homework using the computer. While the traditional approach requires students to spend a goodly amount of time calculating figures for a worksheet, a general ledger software program can prepare the entire worksheet and all end-of-the-fiscal-period reports in a few seconds. Thus, more instructional time is available for studying relationships between accounts, productivity, and profitability. Students may advance to "what if?" problems--simulations about market trends, cost recovery programs, aging of accounting receivables, and other types of decision-making programs.

Word processing will be an integral part of the electronic office. This type of office will incorporate electronic filing, database management, and electronic mail. As the "computypewriter" (a combination machine with word processing and data processing functions) becomes the major office input machine, business programs must concentrate on language arts skills, proofreading, input skills, mathematical understandings, and "electronic networking competencies."

Home economics programs must prepare homemakers for the electronic home. This "wired home" will incorporate the computer in shopping, home management, cooking and nutritional analyses, and personal finances and budgets. The cooking process may be started with computers acting as timers or they may be activated by telephone from a remote place. Thus, future homemakers must have a basic understanding and acceptance of the computer. Grocery inventories, recipe files (with caloric information and the ability to increase or decrease the size of the recipe), and other applications should be incorporated in the curriculum.

Marketing and distributive education programs must train workers to operate POS (point-of-sale) terminals as well as to understand the types of records that result from them--inventory records, sales analyses, accounting, and credit records. Most important, the effect of increased sales and/or expenses should be simulated so marketing decision-making skills can be developed. Inventory maintenance for shipping room personnel will involve the computer and hence should be taught. Markups should be calculated on the microcomputer. Electronic sales techniques will need to be added to the sales skills commonly taught today.

Data processing programs at the vocational school level must prepare more computer programmers and operators to meet the ever-increasing demand for trained computer personnel. More teachers must be prepared to teach these skills--and more workers must be prepared to create new, innovative software that utilizes the unique features of the computer in preforming work.

Trade and industrial programs need updating in two ways: (1) electronic training in designing new machines and in servicing existing ones, and (2) training in operating computerized machines such as cutting machines controlled by the computer and computers used in drafting and designing items. In addition, assembly plants may utilize electronic robots for the most part in the very near future--causing a drastic decrease in the number of manufacturing jobs. Retraining of displaced industrial workers will be a major problem.

These are only a few examples of existing needs; technological changes are occurring very rapidly. Hence, more curricular changes and different equipment are forthcoming; they will demand more complex skills by teachers and workers alike.

RECOMMENDATIONS FOR VOCATIONAL EDUCATORS

Vocational teachers should use the computer in teaching job skills and in managing the classroom. Therefore, the following recommendations are made:

Learn to use the computer. Enroll in two types of courses: (1) a course on what a computer is and what it does or does not do, and (2) a course involving simple programming and using software in a specialty area.

Acquire skill in critiquing software programs according to predetermined criteria, such as learning effectiveness, ease of use, appropriate objectives, and appropriate content.

Acquire skills in operating software programs in one's curricular area.

Be knowledgable about the way the computer and related communications technology is currently used in one's specialty area. Update one's work skills in the workplace.

There are many excellent books and articles written about the "Micronics Age." However, the following articles and/or books are recommended as a MINIMUM for all vocational educators:

Martin, James. TELEMATIC SOCIETY: A CHALLEGE FOR TOMORROW. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1981. (Non-technical but highly informative)

Martin, James. FUTURE DEVELOPMENTS IN TELECOMMUNICATIONS, Second Edition. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979. (Non-technical but highly informative)

Shane, Harold G. "The Silicon Age and Education," Phi Delta Kappan, January, 1982.

Uthe, Elaine F. "Will Teaching Be Different in the Year 2000?" KBEA Journal, Spring, 1981 (Appendix).

VocEd, April, 1982 issue.

In addition, vocational educators should read about the computer's effect on society and education in a broader sense; a number of good references appear in the bibliography for this report.

SUMMARY

The computer is here; telecommunication is here. They are causing more career and societal upheavals than the automobile and television did--and in a very short time. The mystic about computers must be overcome by both adults and children.

What lies ahead? More innovative ideas, enhanced by the power of the computer and the fertile minds of those who are trained to use it creatively.

In the Year 2000 people will still cry, laugh, eat, sleep, pay taxes, and have birthdays. The jobs they hold, the places in which they work, and the homes in which they live may be quite different, however, due to technological changes.

The past is gone; it was but a prelude to today; and today is a prelude to the future. Vocational educators must look to the future--the Year 2000 and beyond--and prepare today to meet the challenge of change.

APPENDICES

PLEASE COMPLETE THE FOLLOWING:

Name of Person Providing the Information: ________________________
(Name will remain confidential and will not be used in the final report. The name is requested so that I may contact you later if I have questions about your response)

Correct Job Title: ________________________

May I telephone you if I have questions? ________ Yes. (Area______)______-______

This address is correct.
(If not, please change)

If you have reports or other materials available that explain your responses more fully, will you please send me a copy?

Please return this questionnaire (and any other materials you wish to share) to:

Dr. Elaine F. Uthe
Head, Business Education
University of Kentucky
145 Taylor Education Building
Lexington, KY 40506

TECHNOLOGICAL INVENTIONS. What technological inventions have been made recently or are expected to occur in the future--ones that will affect communications in and between businesses? When do you anticipate actual usage?

Describe anticipated invention and/or application in data processing, word processing, information retrieval, records management, telephoning, reprographics, and telecommunications technology	Exists But Not in Practical Use	Expected Time of Wide Usage				
		1981--1985	1986-1990	1991-1995	1996-2000	After 2001
1.						
2.						
3.						
4.						
5.						

THE FUTURISTIC DREAM. What predictions or dreams do you envision in data processing, word processing, information processing and retrieval, records management, telephoning, reprographics, and telecommunications technology that will affect communications in and between businesses by the Year 2000? What factors do you foresee as major blocks for each prediction or dream?

Describe predictions or dreams	Major Block(s)
1.	
2.	
3.	
4.	
5.	

THE FUTURISTIC DREAM. What predictions or dreams do you envision in data processing, word processing, information processing and retrieval, records management, telephoning, reprographics, and telecommunications technology that will affect communications in and between businesses by the Year 2000? What factors do you foresee as major blocks for each prediction or dream?

Describe predictions or dreams	Major Block(s)
1.	
2.	
3.	
4.	

5.

TECHNOLOGICAL INVENTIONS. What technological inventions have been made recently or are expected to occur in the future--ones that will affect communications in and between businesses? When do you anticipate actual usage?

Describe anticipated invention and/or application in data processing, word processing, information retrieval, records management, telephoning, reprographics, and telecommunications technology	Exists But Not in Practical Use	Expected Time of Wide Usage				
		1981-1985	1986-1990	1991-1995	1996-2000	After 2001
1.						
2.						
3.						
4.						
5.						

PLEASE COMPLETE THE FOLLOWING:

Name of Person Providing the Information: ______________________
(Name will remain confidential and will not be used in the final report. The name is requested so that I may contact you later if I have questions about your response)

Correct Job Title: ______________________

May I telephone you if I have questions? ________ Yes. (Area______)______-______

This address is correct.
(If not, please change)

If you have reports or other materials available that explain your responses more fully, will you please send me a copy?

Please return this questionnaire (and any other materials you wish to share) to:

Dr. Elaine F. Uthe
Head, Business Education
University of Kentucky
145 Taylor Education Building
Lexington, KY 40506

APPENDIX B

Will Teaching Be Different In The Year 2000?

Elaine F. Uthe
University of Kentucky
145 TEB
Lexington, KY 40506
Head, Business Education

Yes, and so we must prepare today! The Electronic Revolution is about over - - microprocessors have been on the market for several years and are appearing in our everyday lives even though we do not recognize them. We are in the Electronic Age already--and you probably have twenty microprocessors in your home today.

Information is a vital commodity in business, politics, international trade, and consumerism, for example. As a result, teachers who prepare young people about business and for business must revitalize and change their curricula and teaching methods.

INFLUENCES ON CURRICULUM

What are the factors influencing our curriculum? There are many, but here are a few:

Business Factors

Mini — and microcomputers will be built into all new typewriters giving them the capacity to do both data processing and word processing. Such machines (what will they be called?) will exist in network configurations including printers, copiers, electronic files, and other peripherals. Some networks may be (a) internal -- operated by one company, or (b) external -- through public communications systems; but either type may occur in local, nationwide and/or international configurations.

The telephone system will be interfaced with the computer/typewriter. Larger companies will have some videophones (video display on computer screen of caller and answerer), probably in top executive offices and conference rooms. Teleconferences will be commonplace and replace much of executive travel.

All but the most backward companies will install phones that receive electronic messages in either visual display or voice styles. In fact, when the phone rings, the answerer can ask for a display of the phone number and caller's name before answering the phone - - thus avoiding unwelcome calls.

The post office may no longer exist as the hand-delivery system is exorbitantly expensive and all the postal clerks and mail deliverers have retired. Package delivery companies (private enterprise ones) will deliver any letters or printed materials that cannot be sent electronically.

International phone calls by a person or the company computer will be commonplace.

Miniaturization has taken place; handheld computers installed in briefcases (or in wristwatches) travel with every executive and sales representative for record-keeping and communicating with the company's mainframe computer via the telephone wires. Remote telephones -- sometimes a handheld device and sometimes in a wristwatch device – are carried by all workers who are needed "on demand" ——executives, service representatives, and supervisors (and perhaps teachers).

Also, offices are much quieter. Typewriters (if they are called that) have touch sensitive keypads (such as on a microwave oven or electronic calculator) instead of mechanical, clacky keys. In fact, Sony released the Typecorder in early 1981, and it may be forerunner for the Year 2000 typewriter. The Typecorder (3 pounds, 8½" x 11" x 1½" thick), has an electronic typewriter keyboard with data processing symbols and a one-page memory with a one-line display window for editing. The user may store up to 120 pages of typing or dictation on its built-in microcassette; it has a built-in communicator for sending data back to the office over the telephone lines.

Political Factors

Computers and the Information Age raise anxiety about privacy for the individual, governmental controls, values, and new laws.

Cable TV with interactive channels (where the viewer can express an opinion or give an answer by pressing a button on a microproccessor connected to the TV and the station's computer) can be used for polls (such as the A.J. Nielsen or Gallup polls), entertainment (such as the "The Magic Touch" program aired in Columbus, Ohio, and elsewhere), and voting. Debates will still be held in the Year 2000 about voting through the home computer; it involves voter registration by name, Social Security or other national number, and perhaps a fingerprint. The computer will then check to see if you are registered, that you are the right person, and that you have not registered or voted more than once. Perhaps every baby born in the Year 2000 will be registered by name, Social Security number, and fingerprint!

Nationwide telephone numbers will exist for every person also, based on their name, Social Security number, fingerprint–and a "geographic location" code. Therefore, only one phone directory will be needed for the nation--and it will be in the computer. So where do you go to get away from the phone? Flip the switch to receive only electronic messages in memory for retrieving later at your convenience!

International Trade Factors

Satellite communications will replace most "wire" systems; fiber optics systems will replace copper wire ones resulting in reduced costs and increased services – transmittal of data, video, and sound. AT&T is no longer a protected monoply but is competing with other satellite systems.

Transborder data flow–transmittal of information across national borders–still causes problems internationally. Some governments control TV and radio systems in order to maintain control of people, collect profits from transmissions, and maintain nationalities. Rooftop antennas that receive satellite transmissions, however, counteract governmental controls much like the Voice of American broadcasts during World War II and later.

A universal language--a form of English--takes over so that international flow of information, data, and computer programs are compatable.

Developing countries strive to build data processing capabilities of their own to maintain freedom, gain access to information, and create their own data, nationality, and military independence.

Consumerism and Societal Factors

Almost every home will have an electronic network including a TV, telephone, computer and memory/printer. This system will transmit video, data, sound into the home and will also transmit it out of the home--an interactive system. Electronic mail, electronic funds transfer (banking), shopping, entertainment, voting, educational programs, library searches--even electronic news and weather forecasting--will enter the home on this system.

Microprocessors (part of the same system or standalone items) will regulate appliances, the heating/cooling system, burgular alarms, and cars. Perhaps one or more robots will help with the housework!

Credit cards will change; the magnetic strip on the back will "contain" a specified amount of cash. When the card is used for a purchase, it is run through a "point-of-sale" register at the store (or in your home) and the cash amount is reduced electronically. No more bad checks! Security against a lost or stolen card is built in as the user must know the "password" built into the electronic strip.

Implications For Curriculum And Teaching

Every one of the factors cited above exists today in one form or another although they are not necessarily in practical or widespread use yet. Still others are to come.

How will teaching be different in the Year 2000? There are many ways, of course, but here are a few:

The computer has and will continue to demand changes in curriculum. "Computer literacy" must be taught–that is, everyone must learn what a computer is, how it works in general, what it can do and is doing in their lives, what controls are needed, and how to run the computer in their own lives (bank terminals, library searches, setting burglar alarms, etc.) Programming must be taught, both at a simple elementary level and at the career level.

Career education about occupations affected by the computer must be offered: (1) careers in data processing; (2) careers in service and maintenance relating to computers and microprocessors; (3) careers related to security to prevent and/or trace crimes, embezzlements, and invasions of privacy, for example; (4) careers in electronic engineering and design; (5) careers in business management and procedures; and (6) careers in other fields that depend heavily on use of computers such as telecommunications, health and medicine, and government.

The secretarial function may or may not (should?) change in the electronic office. Will secretaries still exist if every executive has an electronic workstation that he/she uses to gather data, put data in, file, receive messages, and so forth? Or will the secretary be the executive? Or if both the executive and the secretary still exist and work together, what will the secretary's functions be?

Great care and study should be directed to determining the role of the secretary in the electronic office today and in the future; curriculum may need to place much more emphasis on data processing and decision making roles.

The "schoolhouse" and the "classroom" in the Year 2000 may not resemble today's institution. Instead, teachers may teach from their homes via the interactive communications network of TV, phone, and computer; students may study at home.

Various types of teachers will be needed: (1) expert designers of instructional materials that unite content using video slides and/or motion films, sound, and print (now known as videodisc systems with computerized random-access memory; (2) master electronic-minded teachers who use these instructional materials while interacting with students over the interactive network (with the computer grading students' input in most cases and maintaining records while the teacher "teaches" and smoothes the way); and (3) master discussion-type teachers who meet with small groups of students in central locations for verbal discussions about topics not readily taught electronically.

Electronic teachers may teach students in many locations--aroung the corner, in the next state, in another country–the only limit might be the limitations of the computer and the cost of long-distance rates; however, if only one teacher in the nation taught Subject X #3C) + 44, then cost could not be a factor.

The Future

Different? Yes! How much different? No one knows for sure. Exciting? Yes! Will we really be going all these things by the Year 2000? We do not have any choice about the existence of the computer, satellites, telecommunications, and their effect on the business world and our private lives. There is a big question about how much we accept as a society–for example, the question of working/teaching/studying from your home. Some communities may accept that earlier than others.

Furthermore, the turn-around time or obsolescence factor for computers is rapidly decreasing from five to three years, so we may see many more and very different innovations by the Year 2000.

If you have time and the interest, I encourage you to read a very delightful book written in nontechnical language by James Martin–THE WIRED SOCIETY (Prentice-Hall, Inc., 1978).

I also urge you to enroll in a computer literacy and/or a beginning level programming course--you are the teacher today and you are teaching students for the future!

Computer Literacy for the Year 2000

ELAINE F. UTHE

The computer is decreasing in size and cost while increasing in power as creative applications expand daily. Among the applications that already exist or may be practical before the year 2000 are talking cars that remind drivers about service needs; memory cards with embedded microprocessors that serve as passports, transcripts, employment records or medical histories; electronic mail; "credit cards" with embedded microprocessors for electronic funds transfer; personal computers as small as wristwatches; voice-activated typewriters; computer-controlled homes; electronic news and computerized libraries.

> Everyone—regardless of age or career goal—must develop computer literacy, an understanding of what computers are and how they affect work and personal lives.

Everyone, regardless of age or career goal, must develop computer literacy—an understanding of what computers are and how they affect work and personal lives, and the ability to operate routine programs on computer terminals.

As the computer permeates all areas, workers must be trained to operate routine computer programs in their own specialties. For example, office workers should be trained in word processing and electronic filing, accounting and payroll. Graphic arts and drafting workers need training in electronic phototypesetting and computer-controlled printing presses. Workers in both graphic arts and drafting need training in generating graphics by computer.

Marketing workers need to learn to design marketing strategies on computers. Medical secretaries and technicians need training in operating computer terminals for maintaining medical records and operating laboratory equipment. Machine shop, electronics and drafting/engineering programs must incorporate computer-assisted design techniques.

As a result of the increasing use of computers, the year 2000 will require less physical labor for all workers, especially for information processors. However, training will be needed in problem solving, troubleshooting, attitudes and ethics, as well as clarity and conciseness in communicating with computers and people.

More emphasis should be placed on math, especially in judging whether machine calculations are correct rather than on drilling for calculation skills. Work simplification skills, workflow concepts and attitudes about productivity must be stressed in all programs.

Individualized instruction will be enhanced through the use of videodiscs that combine sound, motion, slides and programmed text into one system. Software will help teachers evaluate students' answers, compute grades and determine branching within the course of study. In addition, computerized simulation activities will be developed.

As telecommunication networks develop, training may take place any time and any place. The teacher may be at home, 500 miles away or in the classroom, and the student may be in a formal classroom, at work or at home. Individualized instruction can occur using a computer terminal and central computer via telephones or cable television.

Training new workers and retraining adults for a computerized future is essential, and the need for adult education at school or industry settings will continue to expand.

The generalist "computer operator" will be a common job title in business and industry. This worker will use a terminal to perform routine operations in all fields—for taking classified advertising for an electronic or printed newspaper; doing literature searches; maintaining inventory records, production analyses, chemical testing and medical records and other activities.

Electronic designers and service/repair representatives will be needed in increasing numbers and in every field, including computers, auto mechanics, copiers and manufacturing equipment.

Computerized graphic design may replace drafting just as the programmable calculator is replacing the slide rule.

Secretarial/mid-manager positions may merge as data processing and word processing are done on the same computer terminal or electronic typewriter. As secretaries, typists and general office workers operate routine computer software programs, they may become the mid-managers of the year 2000.

The need for data processors from programmers to systems analysts will continue to increase. The "manager of information services" will oversee data processing, telecommunications, record management, word processing and reprographics areas. The duties of data processing librarian and records manager will continue to increase as filing via computer becomes more widespread.

As the number of computer-related occupations increases, master teachers with vocational expertise, programming skills and creativity will be needed in every area.

Technology may change but employers will always want workers who are competent, willing to work and willing to learn. Acceptance of technological changes comes from familiarity and training both for vocational teachers and their students. Let's prepare now for the year 2000!

Elaine F. Uthe is head of business education at the University of Kentucky.

(VocEd Technical Insider), November-December, 1981

The Computers in Our Lives

by Elaine F. Uthe

The computer prevails today in government, industry, business and science and the use of miniaturized computers and microprocessors in vastly new applications is expected to expand at tremendous rates through the 1990s and into the year 2000. The changes in career and work patterns resulting from new computer and communication technologies are going to have a profound impact upon vocational education. Educators are only now recognizing and attempting to meet this challenge.

Vocational educators—leaders, administrators and teachers alike—face a two-fold task: acquiring computer literacy themselves and training workers to use computers and computerized equipment on their jobs. The problem is complex because of the rapidity of change and the ever-increasing number of applications in every vocational field. Developing and maintaining programs is difficult when computer technology changes every three to four years and when new capabilities and software constantly appear. The need is urgent, however.

Already, information workers comprise over 50 percent of the labor force. Equally important, the computer is used in so many applications today that the entire work force is affected. All workers—prospective or experienced—must be prepared to understand and operate computers as a tool in the same way that they use a typewriter in office work, a hammer in construction and a ruler in drafting. Fortunately, today's microcomputers are easier to use than the million-dollar, room-size computers of the 1950s. The average person can learn to use a microcomputer with a minimum of training.

The range of use is enormous. Business offices use computers for accounting purposes—accounts receivable, billing and invoicing, payroll, inventory control, accounts payable, general ledger, sales analysis and cost analysis. Word processing is growing rapidly, often combined with other computer capabilities. Electronic mail systems via satellites and telephones are rapidly emerging.

Recordkeeping and database functions are not restricted to business offices. Computers keep track of supplies, shelf stock and equipment for grocery stores, warehouses and assembly plants. Farmers use computer software for herd improvement, identifying productive animals and planning best-feed diets. Hospitals and doctors' offices file patients' records electronically and recall them by computer terminal. Libraries and commercial data bases provide information on any conceivable topic—provided the user has access to a computer and knows how to use it.

Computer graphics have many applications. Managers use computer graphics to condense volumes of data into trend-line charts, graphs and diagrams—often in color. Landscape designers draw simulated cities with buildings, streets and plantings, rotating the simulation on the screen to view all sides and dimensions. Using computer-aided design (CAD), engineers design an auto part, display it on the computer screen, view it from all sides, modify it easily, save it for later reference. The computer can be programmed to calculate all types of stress points and even determine if one part meshes with another. Buildings, shoes, machine tools, airplane parts, bridges, textiles, clothing, needlepoint—all can be designed and modified using the computer. Even artists are using computer graphics in their work.

Problem-solving simulations enable farm managers to perform crop rotation analyses, homemakers and dieticians to perform nutritional analyses, business managers to prepare budget projections and sales managers to work out market analyses and projections.

As these few examples show, computer capabilities touch all vocational fields. They also give rise to important concerns about computer applications in the political and social affairs that affect workers.

Computers and satellite communications have combined to shrink the world to the size of a dot. A businessman in Lexington, Kentucky, can telephone halfway round the world to Paris, France, in about the same time that it takes to call someone just 20 miles away in Paris, Kentucky. The new technologies raise questions about international trade and data flow, privacy and freedom of information, security and crime. Not only are the lives of individuals already affected as consumers and citizens, but the home itself may change as work and learning increasingly take place in the "wired" home.

The rapidity of communications via satellite makes it possible for a New York company to sell midnight-to-6 a.m. computer time to foreign firms in a different time zone. American television shows are beamed around the world. The buying countries become Americanized in thought or information-dependent, increasing their economic dependency.

Interactive cable television systems raise concerns about the right of an individual to privacy. The television company's computer can easily check the number of viewers for each program—and then sell the information to advertisers. With a home computer, it may be possible to vote from home, presenting problems with registration procedures and identification. (Perhaps the computer will register the thumbprint or voiceprint of the person pushing the voting "button.")

A balance between the government's and the individual's need for information must be struck as computers are used to match IRS returns, welfare payments, unemployment benefits, criminal records and credit records against social security numbers. In time, "memory" cards with imbedded microprocessors will encode an individual's identity: passport, medical history, employment record and recommendations, library card, driver's license. With an electronic money card, an individual's transactions at stores or banks will transfer funds immediately. Computer crime is already a problem. Entirely new careers have emerged in attempts to make computers "fail-safe" (no shut-downs), inaccessible to unlawful users, and accurate.

The wired home—hooked up by microcomputer to a cable system and telephone—is going to change the way people live and work. Whatever can be done with a microcomputer will be done in the home—studying, research, work. Teachers will teach from their home and take graduate courses from home. Workers will abandon commuting for telecommuting. The home will be the site for electronic shopping, electronic news, electronic banking and electronic recreation.

Even this quick overview is sufficient to make it clear that the technological changes brought about by the computer and advanced communications systems involve great societal changes. These changes have already begun, and many more will come. They will have a profound effect upon vocational education.

Therefore, vocational teachers and administrators must become computer literate—knowledgeable about computers and able to use them. Since all careers will involve computer use, curriculum in all vocational programs must incorporate computers as a job tool and an instructional aid. The acquisition of computers and computerized equipment is imperative for vocational schools and technical institutions.

Each vocational program must be carefully examined to determine curricular changes made necessary by the increasing use of computers. For example:

Office education must concentrate on language skills, proofreading and input skills. Word processing will be important in the electronic office. Students need to learn filing, database management, electronic mail, report-writing using both words and calculations, and production typewriting.

Business and office programs should require accounting students to use the computer to prepare homework. The time traditionally spent in calculating figures for a worksheet can be drastically reduced: a good general ledger software program can prepare the entire worksheet in a matter of seconds at the touch of one key. Thus, more instructional time can be spent on studying relationships and determining profitability. Also, students may advance more rapidly to "what if?" problems—simulations about market trends, cost recovery programs, aging of accounts receivable, and other decision-making problems.

Home economics programs must prepare homemakers for the electronic home. This wired home will incorporate the computer in shopping, home management, cooking and nutritional analyses, personal finances and budgets and electronic shopping as well. All these applications should be incorporated into the curriculum to prepare future homemakers.

Marketing and distributive education programs must train workers to operate point-of-sale (POS) terminals as well as to understand the type of records that result from them—inventory records, sales analyses, accounting and credit records. Most important, the effect of increased sales and/or expenses should be simulated so marketing decision-making skills can be developed. Inventory maintenance for shipping room personnel will involve the computer and hence should be taught.

Trade and industrial programs need updating in two ways: electronic training in designing new machines and in servicing existing ones, and training in operating computerized machines such as cutting machines controlled by the computer and robots used in assembly plants.

Data processing programs at the vocational school level must prepare more computer programmers and operators to meet the ever-increasing demand. More teachers must be prepared to teach these skills—and more workers must be prepared to create new, innovative software that utilizes the unique features of the computer in performing work.

Few vocational programs are equipped with computers today, except for those in data processing. The acquisition of computer hardware and software has to take place in tandem with preparing teachers to use the computer in teaching job skills and managing the classroom

Each school should prepare a plan for acquiring computers by first determining what capabilities and applications are essential and then identifying the brand of computer that best supports those applications. In the first year at least one machine should be purchased for each vocational program. Time should be given to a lead teacher in the program area to learn to operate and program the computer and to develop skill in using all software programs. Instructional materials can be developed by teachers and used by individual students during this time on an experimental basis.

During the second year the school should acquire additional equipment for students to use. Lead teachers should teach other faculty to use the computer. It should become a familiar tool in each vocational classroom. If only a limited number of microcomputers are available and only a few teachers know how to use them, all the applications in a program area may need to be taught in a special computer class.

As soon as it is financially feasible, schools should provide microcomputers in sufficient numbers and with appropriate software for all vocational students to use in the same way as a book or a pencil. Students should be exposed to the vast array of applications being used on the job in today's world of work.

Meanwhile, all teachers should get ready for the computer in the classroom. They need to take two types of courses: the first should explain what a computer is and what it does; the second should involve simple programming and using software programs in the appropriate specialty area. They need to learn what the criteria are for selecting good software. Some teachers should train to design software programs for instruction.

And all vocational administrators and teachers should read three items written in nontechnical language about computers and the future: *Telematic Society: A Challenge for Tomorrow* (1981), *Future Developments in Telecommunications*, second edition (1979), by James Martin and "The Silicon Age and Education," by Harold G. Shane (*Phi Delta Kappan*, January, 1982).

To summarize, the microcomputer age is here and it is causing more career and societal upheavals than the automobile did. We must deal with the lack of computer literacy of many vocational educators (as well as educators in other areas), the lack of teacher training programs, the lack of computers in schools and the lack of curriculum using computerized instructional programs.

For what lies ahead is more innovation enhanced by the power of the computer and the fertile minds of those who are trained to use it creatively.

About the author
Elaine F. Uthe is head of business education at the University of Kentucky.

BIBLIOGRAPHY

BOOKS

Barney, Gerald O. THE GLOBAL 2000 REPORT TO THE PRESIDENT. Washington, D.C.: U.S. Government Printing Office, 1980.

Davis, William S., and McCormack, Allison. THE INFORMATION AGE. Menlo Park, California: Addison-Wesley Publishing Company, 1979.

Dertouzos, Michael L., and Moses, Joel. A COMPUTER AGE: A TWENTY-YEAR VIEW. Cambridge, Massachusetts: The MIT Press, 1979.

International Telephone and Telegraph. TELECOMMUNICATIONS CONCEPTS SERIES, Volumes I-V, no date.

Kahn, Herman, et al. THE NEXT 200 YEARS. New York: William Morrow and Company, Inc., 1976 (Report from the Hudson Institute).

Martin, James. FUTURE DEVELOPMENTS IN TELECOMMUNICATIONS, Second Edition. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979.

Martin, James. TELEMATIC SOCIETY: A CHALLENGE FOR TOMORROW. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1981.

Martin, James. THE WIRED SOCIETY. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1978.

Mathews, Walter M., Editor. MONSTER OR MESSIAH? THE COMPUTER'S IMPACT ON SOCIETY. Jackson, Mississippi: University Press of Mississippi, 1980.

NASA, Contract NAS2-5369, 1970.

Nora, Simon, and Minc, Alain. THE COMPUTERIZATION OF SOCIETY. Cambridge, Massachusetts: The MIT Press, 1980 (Translation of a report to the President of France).

Panati, Charles. BREAKTHROUGHS: ASTONISHING ADVANCES IN YOUR LIFETIME IN MEDICINE, SCIENCE, AND TECHNOLOGY. Boston: Houghton Mifflin Company, 1980.

SMALL COMPUTERS FOR SMALL BUSINESS. Time Marketing Research Report No. 2207, cited by Focus Research Systems, Inc., June, 1980.

Toffler, Alvin. THE THIRD WAVE. New York: Morrow and Company, Inc., 1980.

U.S. Department of Labor. DICTIONARY OF OCCUPATIONAL TITLES, Fourth Edition. Washington, D.C.: U.S. Government Printing Office, 1977.

U.S. Department of Justice. COMPUTER CRIMINAL JUSTICE RESOURCE MANUAL. Washington, D.C.: U.S. Government Printing Office.

Wallechinsky, David; Wallace, Amy; and Wallace, Irving. THE BOOK OF PREDICTIONS. New York: William Morrow and Company, Inc., 1980.

ARTICLES

Shane, Harold G. "The Silicon Age and Education," *Phi Delta Kappan,* January, 1982, pp. 303-308.

Uthe, Elaine F. "The Computers in Our Lives," *VocEd,* April, 1982, pp. 26-29.

.... "Computer Literacy for the Year 2000," *VocEd Insider,* November-December, 1981, pp. 52g-52h.

.... "Will Teaching Be Different in the Year 2000?" *KBEA Journal,* Spring, 1981, pp. 16-18.

PERIODICALS (Issues from 1980-1982; specific pages noted as citation was noted in the text)

Administrative Management

Business Week

Computerworld

Delphi

Forbes

Fortune

Infoworld

Information Hotline

Insight, National Space Institute, March/April, 1981.

MIS Week

Modern Office Procedures

Wall Street Journal

Word Processing Report